EASY-TO-USE STAR CHARTS

OBSERVING TIPS FOR EARLY SPRING

MARCH/APRIL 2016

SkyNews

The Canadian Magazine of Astronomy & Stargazing

LUCKY PLANET

Did a rare combination of cosmic coincidences make Earth suitable for four billion years of life?

The Moon's Scarred History

Jupiter: The King of Planets Is Bright in Early-Spring Sky

+

Hydra Raises Its Serpentine Head

New Portraits of Celestial Wonders

Chasing (and Catching) Meteors

visit skynews.ca

PORTRAIT OF EARTH TAKEN IN 2015 BY THE LUNAR RECONNAISSANCE ORBITER

Wildlife Season

Sky-Watcher
Be amazed.

See farther, get closer.

© Ben Tsai

Binoculars

Supra 1042 & 842

Diameter	42 mm
Magnification	10× and 8×

Spotting Scope

ST 80A and tripod

Aperture	80 mm
Focal Length	480 mm
Magnification	20× — 60×

Short Tube

1025 AZ3

Diameter	102 mm
Focal Length	500 mm

1206 AZ3

Diameter	120 mm
Focal Length	600 mm

ED Refractor

80 ED EQ3 SynScan

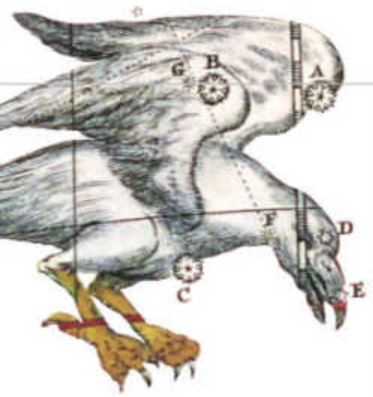
Diameter	80 mm
Focal Length	600 mm
SynScan GoTo with GPS	

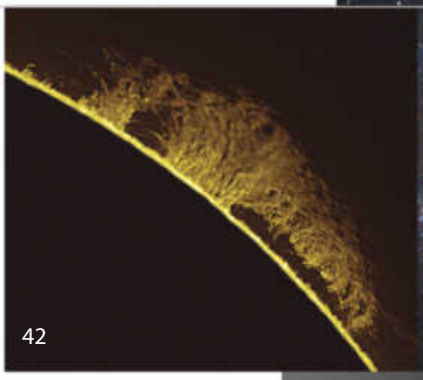
Discover more, please visit
ca.SkyWatcher.com

All-Star Telescope (AB) 403-335-4857
La Maison De l'Astronomie (QC) 514-279-0063
Canadian Telescope (BC) 604-336-3821
Lire La Nature (QC) 450-463-5072
Focus Scientific (ON) 613-723-1350
New Eyes Old Skies (ON) 905-883-9191
KW Telescope (ON) 877-345-5757
Vancouver Telescope Centre (BC) 604-737-4303

MARCH/APRIL 2016
Volume XXI/Issue 6

CONTENTS





COLUMNS

DEPARTMENTS

FEATURES

VISIT US AT
SkyNews.ca

COVER: This striking new view of Earth above the rumpled lunar surface was captured by the telephoto eye of NASA's Lunar Reconnaissance Orbiter. It emphasizes the stark differences between the airless, waterless and largely changeless Moon and our dynamic home world. COURTESY NASA

by Terence Dickinson

Viewing Earth From Afar

Lunar Reconnaissance Orbiter captures vibrant Earth above cratered, lifeless lunar landscape

TWO WORLDS so close together, yet so different. One is teeming with life in its oceans, on land and in its atmosphere. The other is barren, as dry as dust, largely unchanged since its birth. But that birth profoundly altered the evolution of both worlds.

Just how our Moon—two-thirds the size of the planet Mercury—was created and came to be orbiting Earth was a mystery until the 1980s. For more than a century, astronomers had debated the merits of three scenarios: the adopted-cousin theory (the Moon was a small planet gravitationally captured by Earth), the sister theory (Earth and the Moon were born as a double planet) and the daughter theory (the Moon fissioned from a rapidly spinning primordial Earth).

Studies of the 842 pounds of lunar material returned by the Apollo astronauts failed to support any of these theories. Instead, a fourth hypothesis emerged and is now widely accepted.

The new view—we'll call it the chip-off-the-old-block theory—is a product of modern computer simulations of the formation of the solar system. These simulations suggest that 10 million years or so after the solar nebula initially evolved into a primordial disc centred on the newborn Sun, the material in the region where Mercury, Venus, Earth and Mars eventually would orbit had built up thousands of mountain-sized planetesimals. These, in turn, collected into perhaps a dozen large bodies in the Mercury-Mars zone. Earth

THE SIGNIFICANCE OF THE MOON The creation of the Moon was the most important event in the Earth's evolution as a life-bearing planet. Having a large satellite stabilized the Earth's rotation axis and climate cycles, leading to an extended era of conditions hospitable for life—an era that continues into this millennium.

COURTESY NASA/GODDARD/ARIZONA STATE UNIVERSITY

SkyNews

VOLUME XXI, ISSUE 6

Founding Publisher Canada Science and Technology Museum
Editor Terence Dickinson
E-mail address skynews@skynews.ca
Art Director Janice McLean
Associate Editors Alan Dyer, Ken Hewitt-White
Production Manager Susan Dickinson
Contributing Editors Christine Kulyk, Glenn LeDrew, Peter McMahon, Ivan Semeniuk, Gary Seronik
Contributing Astrophotographers Klaus Brasch, Ron Brecher, Lynn Hilborn, Malcolm Park

Publisher J. Randy Attwood
Associate Publisher Colleen Moloney
Advertising Manager David Webster 416-924-7973
Business Manager Renata Koziol
Customer Service Denise Havers 1-866-759-0005 service@skynews.ca

skynews.ca

Subscriptions One year $26, two years $42 (plus sales tax); U.S. addresses: one year US$26; two years US$42; International: US$33 per year.

Published six times a year by SkyNews Inc., 203–4920 Dundas Street West, Toronto, ON M9A 1B7

Printed in Canada ISSN 0840-8939

PUBLICATIONS MAIL AGREEMENT NO. 40032351

RETURN UNDELIVERABLE CANADIAN ADDRESSES TO CIRCULATION DEPT.
SKYNEWS, BOX 1613, BELLEVILLE, ONTARIO K8N 5J2

HOW TO GET IN TOUCH WITH SKYNEWS

• **To subscribe:** The easiest way to subscribe to *SkyNews* is to call toll-free 1-866-759-0005 and order by credit card. It's a free call from both Canada and the United States. By mail, use the postage-paid subscription card bound into every issue.

• **To order a gift subscription:** By credit card, use the toll-free line: 1-866-759-0005. By mail, use the postage-paid gift-subscription card bound into every issue.

• **Change of address:** Call toll-free 1-866-759-0005, and have your old address label handy for reference. Or write: *SkyNews*, Box 1613, Belleville, ON K8N 5J2

• **Our mailing list:** Occasionally, we make our subscriber list available to carefully screened companies whose products and services may be of interest to our readers. If you prefer to have your name removed from this list and not receive these mailings, please write to us at the above address or call toll-free 1-866-759-0005.

• **Problems with your subscription:** Call toll-free 1-866-759-0005, and have your address label handy for reference. Or write: *SkyNews*, Box 1613, Belleville, ON K8N 5J2

• **Letters to the Editor:** We welcome letters, especially letters about your astronomy and stargazing experiences. E-mail: skynews@skynews.ca

• **Submitting photographs:** We welcome submissions of astronomical photos taken by our readers. Digital images by e-mail should be sent in jpeg format to photo@skynews.ca

• **Submitting articles:** Please request our writers' guidelines. Mail: *SkyNews*, 203–4920 Dundas Street West, Toronto, ON M9A 1B7 E-mail: skynews@skynews.ca

Canada

We acknowledge the financial support of the Government of Canada through the Canada Periodical Fund of the Department of Canadian Heritage.

FSC www.fsc.org MIX Paper from responsible sources FSC® C011825

might have had four or five neighbours up to three times the mass of Mars, all closer than Mars is now.

Then, bang!

One of them smashed into the nascent Earth. The enormous amount of heat generated by a collision with something that big would have completely melted the surface of our young planet.

Debris from both Earth and the impacting body splashed into nearby space. Some of the ejected material fell back to Earth, but a portion lingered in orbit around Earth and eventually coalesced into the Moon.

That, in brief, is the chip-off-the-old-block theory. Astronomers have accepted it because it is the only explanation for the Moon's origin that fits with the Moon samples gathered by the Apollo astronauts. Those samples revealed that Moon material is different enough from Earth rock that the sister and daughter theories became untenable. However, Moon rock is enough like Earth rock that the adopted theory fails as well.

The Moon contains very little iron and volatiles (more easily vaporized substances), such as water, chlorine and potassium, which indicates that the Moon was at one time heated to incandescence, presumably caused by the giant primordial impact.

The chip-off-the-old-block theory also explains the uniqueness of the Earth-Moon duo among the planets in our solar system. No other planet has a satellite anywhere near as big as itself.

Around 1990, the same time that the collisional origin of the Moon became mainstream science, astronomers specializing in orbital dynamics began using new supercomputers of unprecedented power to simulate what else might have happened to the planets going back in time, then forward in time. It turns out that the solar system was a violent neighbourhood in which to grow up. It still might be in the future.

Venus, the closest planet to Earth in space (it's the next planet in toward the Sun), is nearly identical in size to Earth. Yet under its cloak of sulphuric acid clouds is a hellish environment: a rocky, griddle-hot landscape, at 465°C, immersed in an equally hot carbon dioxide atmosphere.

IMAGINED EARTH-LIKE WORLDS
Before the dawn of the space age, the most influential renderings of possible planetary landscapes were paintings by veteran Hollywood artist Chesley Bonestell, who completed his best-known works in the 1940s and 1950s. These examples of his illustrations are the deserts of Venus (top) and the "canals" of Mars, which appeared in *The Conquest of Space*, published in 1949. Like many illustrations of Bonestell's era that attempted to depict conditions on other planets, the scenes were inevitably tainted by dreams of other Earths. Today, there is still a good possibility that our imaginations will remain Earth-centric.

The most Earth-like world in the solar system in terms of size and location is, in fact, a no-go zone for human exploration. One thing about Venus which offers a clue that something happened in the past to set it on a different course from Earth is its rotation. The planet rotates backwards.

When we look down from above the north side of the solar system (i.e., the Earth's north), Venus rotates clockwise. Yet all the other planets rotate counterclockwise. And Venus's rotation is *slow*. A single day from one sunrise to the next is 117 Earth days. Not that it makes any temperature difference on Venus because the furnace conditions at the surface vary little from day to night.

The best explanation is that in the early days of the solar system, when Earth got whacked by a Mars-sized protoplanet, Venus did too. But the angle of impact or the nature of the impacting body meant that no moon formed, though Venus's bizarre rotation remains as evidence.

Moving forward, the computer simulations suggest that orbital instabilities in Mercury's orbit will fling it out of its position in a billion years or so.

And there's more. For the planets to end up where we see them today, Neptune had to have been closer to the Sun than Uranus was during the first 650 million years of the solar system's existence. Apparently, the two outer giants engaged in some orbital gymnastics and traded places, and they have remained there ever since. If this did not happen, astronomers find it difficult to explain how the planets formed in the first place.

Are you getting the idea that our solar system is a dynamic, if not dangerous environment? Why are Earth and Venus so different? After the excitement of the Moon's formation, why did Earth settle down into a world that has harboured life for the past 3.8 billion years, or 85 percent of our planet's existence?

To put this last question in proper perspective, consider that our life-giving Sun is now one-third hotter and brighter than it was 3.8 billion years ago. Yet our global climate has remained relatively benign throughout that period. Moreover, our atmosphere today is completely different than it was just one billion years ago. There was little oxygen back then, for one thing.

In the months and years ahead, we are going to hear and read more news of the search for other Earths and the discovery of "habitable planets" orbiting other stars. Such assertions are premature when it is still a profound mystery how life got started here in the first place.

Although an exoplanet may have an Earth-like mass and an Earth-like orbit around a Sun-like star, there are many, many more variables involved. ✦

GOLD MINE FULL MOON

On October 26, 2015, I photographed the full Moon rising over Timmins, Ontario. I shot from six kilometres away so that the Moon would be more prominent in the image. I then combined six of the shots into this composite to show the progress of the moonrise, which is caused by the Earth's rotation. I used a 420mm f/7 telephoto lens on a Nikon D800 DSLR for the 1/60-second shots at ISO 400.

The tall building in the photo is a closed mining headframe called the McIntyre, an iconic structure in Timmins. The Porcupine Gold Rush started in 1909 after gold was discovered around Porcupine Lake. Completed in 1927 by Sandy McIntyre, the six-compartment mine-shaft excavation underneath the McIntyre headframe (No. 11) was 4,250 feet deep. In its early days, the McIntyre Mine was a nightmare of problems. One mine manager remembered how he ran to the bank with hot bullion bars to cover a payroll. From 1912 to 1988, 37,529,691 tons were milled, producing 10,745,361 ounces of gold.

Mark Clement
Timmins, Ontario

WHEN HELL WARMS UP

Given Pluto's legendary and perennial link to Hades, it is very appropriate that the New Horizons probe has found evidence "to support a layer of water deep below the surface, sandwiched between an icy mantle and a rocky core [*SkyNews*, Nov./Dec. 2015, page 11]," for the watery underworld makes for a perfect subterranean hell. Albeit an ironic hell, as its –235°C surface temperature makes it clear that the phrases "when hell freezes over" and "a cold day in hell" will have to be changed to "when hell warms up" or "a warm day in hell." Yipe!

How fitting, too, that the dark, cratered and creepy terrain west of Sputnik Planum should be christened the "Cthulhu Regio," given H.P. Lovecraft's fascination with all things dark, creepy and diabolic. Clearly, the call of Cthulhu has proven irresistible once again.

Gary Wright
Mississauga, Ontario

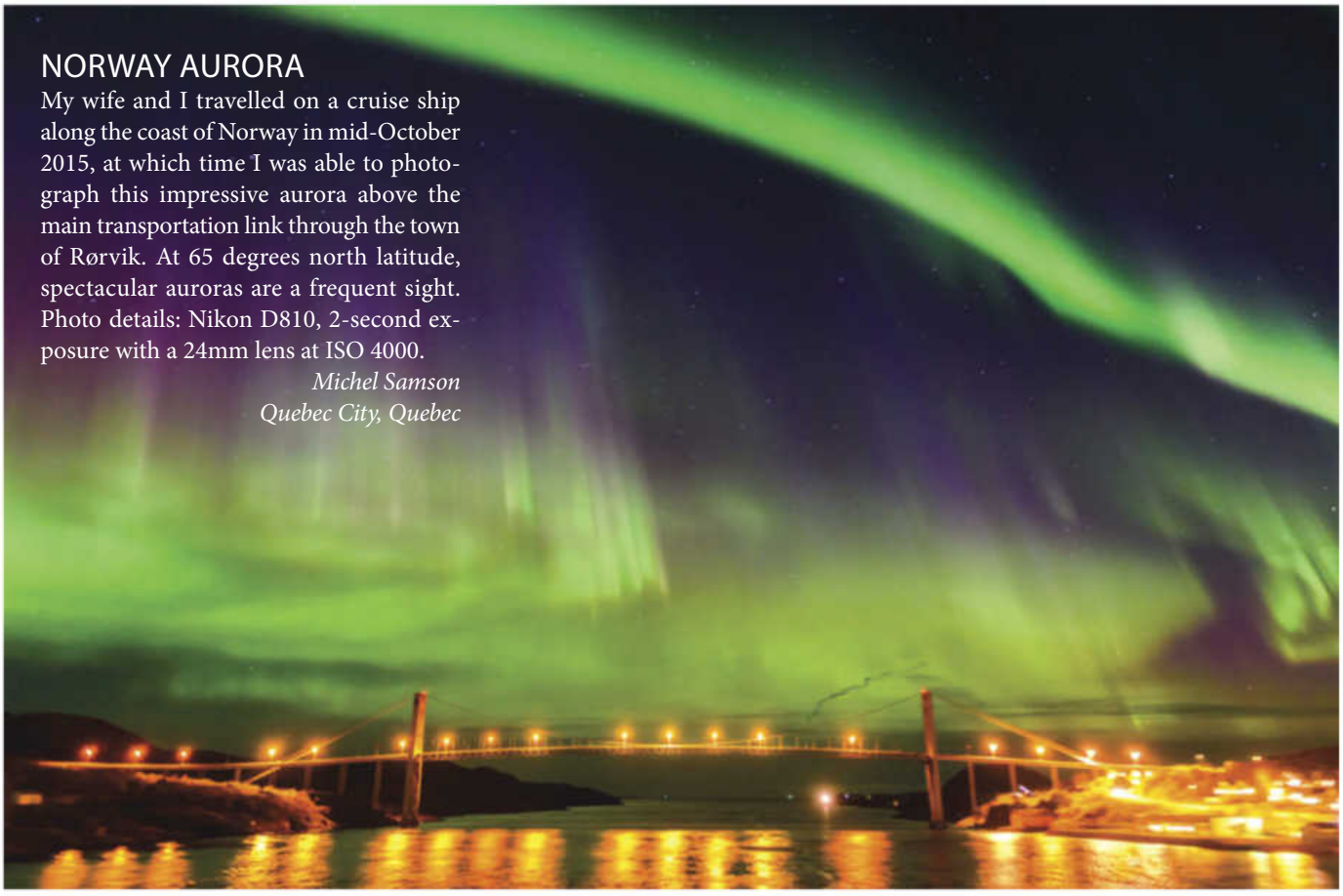
HALLAM OBSERVATORY, RASC WINDSOR CENTRE

A couple of years ago, I learned about the *Voyage* Scale Model Solar System, located on the National Mall in Washington, D.C. Built in 2001 using a 1 to 10 billion scale, the model shows all the planets, including Pluto. Little did I know that someone in our astronomy club was about to construct something similar.

Dave Panton, a retired engineer and a member of the RASC Windsor Centre since 1997, is actively involved with our Hallam Observatory, where he has built all kinds of devices, such as the motorized rotation system of the dome.

This time, Dave decided to build a solar system model showing the five naked-eye planets to scale. All the planets are solar-powered and internally lit, plus they are the right colour. They are encased in sturdy boxes, some of which are mounted on the deck railings, while others are on posts in the field.

The distance between the railings is the basis of the system, representing the distance between the Sun and Earth



NORWAY AURORA

My wife and I travelled on a cruise ship along the coast of Norway in mid-October 2015, at which time I was able to photograph this impressive aurora above the main transportation link through the town of Rørvik. At 65 degrees north latitude, spectacular auroras are a frequent sight. Photo details: Nikon D810, 2-second exposure with a 24mm lens at ISO 4000.

Michel Samson
Quebec City, Quebec

(1 AU). The Sun and the inner planets, including Earth, are mounted on the railings. Sit at the northern rail of the deck (Earth), and look at the model Sun, which is the exact same diameter as the Sun in the sky. Using this scale, Mercury, Venus, Earth, the Moon, Mars, Jupiter and Saturn are all built in proportion to their sizes.

Sit at Earth with binoculars, and you should be able to see Jupiter's Galilean moons and the cloud bands on the giant planet's surface. Saturn is shown with its rings as they will be in 2017. Cassini's division can be seen with a small telescope.

Uranus and Neptune were not built, mainly because of their large distances. When Dave started the project, he was going to build only the inner planets. But after receiving feedback from visitors, he decided that more planets were needed. What an amazing enterprise! Much credit goes to Susan Sawyer-Beaulieu, John Marn, Alan DesRosiers and Steve Mastellotto, who helped Dave along the way.

We are lucky to have this new addition to our observatory, and when heavy clouds cover the sky, we can still show the planets. And that feels good.

Juliana Grigorescu
Windsor, Ontario

PLANETS TO SCALE Centred on the Hallam Observatory (below) of the RASC Windsor Centre, the solar system model utilizes solar-powered enclosures for Mercury to Saturn. Club members Dave Panton and Alan DesRosiers are beside Saturn. PHOTOS BY JULIANA GRIGORESCU

by Peter McMahon

McDonald Park

Vancouver's down-the-road dark sky preserve

POINTING THE WAY An observer at McDonald Park, British Columbia's only dark sky preserve, uses a laser to aim a telescope.
PHOTO BY JASON KAZUTA

ON THE SHORES of the Fraser Valley's Sumas River and set against Sumas Mountain, British Columbia's only designated dark sky park lies roughly an hour's drive from downtown Vancouver and just down the road from the cities of Abbotsford and Chilliwack. McDonald Park is as good an observing site as you can have in such a densely populated region.

After hearing about the founding of Canada's first dark sky preserve at Ontario's Torrance Barrens, Fraser Valley Astronomers Society (FVAS) president Paul Greenhalgh was inspired to preserve the night sky in his own backyard and beyond. "I did some research and put together a proposal to encourage the City of Abbotsford to replace its old glare-bomb-style streetlights with full-cutoff fixtures," he says. The municipality decided to test the idea for a month down the hill from where Greenhalgh and his family live. "The municipality really liked what it saw," he says. "Now the city has decided to install full-cutoff lights in all new subdivisions and replace existing streetlights as they fail with the dark-sky-friendly fixtures."

DARKNESS CLOSE BY: THE BEST OF BOTH WORLDS

The new lighting policy reinforces McDonald Park's geographic advantages. The dark sky preserve's prime observing area is shielded by a ring of mountains that blocks light pollution from Abbotsford in the west, Chilliwack in the east and Mission in the north. Gently rising terrain in the south helps protect observers from the headlights of cars passing by on the Trans-Canada Highway. The site boasts fine views of deep-sky objects toward the south, east and west—something now further ensured by the park's 2003 dark sky preserve designation from The Royal Astronomical Society of Canada.

McDonald Park is a boon for nearby city dwellers who have never witnessed the splendour of the Milky Way. "I remember one star party where I was delivering a cloudy-night talk," recalls Greenhalgh. "Someone came in to report that the skies had cleared, but one skeptical little boy looked out and said that no, it was still cloudy. To resolve the conflicting reports, we went outside, and the boy pointed up at what he thought was a big cloud. It was the Milky Way—he'd never seen it before."

As a result of its efforts, says Greenhalgh, the FVAS has been contacted over the past decade by people from as far away as Germany, Japan and Africa seeking advice on how to create a dark sky preserve.

WHERE TO WATCH: MCDONALD OBSERVING PAD

One of the most satisfying features of McDonald Park is its easy access. It's reached by driving a short distance east on Number 3 Road after leaving the Trans-Canada Highway at exit 104, between Abbotsford and Chilliwack. Amenities at the site are very basic but include a small pavilion and restrooms with running water. Dining, accommodations and a variety of daytime activities are plentiful in the nearby cities.

Around the time the site received its dark sky designation, the City of Abbotsford extended the park by a few dozen metres, put in fencing and allowed the FVAS to build an observing pad for telescopes at the end of the road that leads into the park. Even more exciting is the club's latest project. FVAS members ground and polished a 20-inch mirror for a portable Dobsonian telescope that is now in use at McDonald Park and several other sites in the valley.

Together, the park and the telescope are an impressive combination for club members and the public alike. Greenhalgh remembers one particular visitor: an 82-year-old woman from the United Kingdom who wanted to see Saturn. After a pause, she looked up from the eyepiece with tears in her eyes and said, "I've waited all my life to see that." Before leaving, she asked, "Can I go again?" ✦

Peter McMahon is the manager of the Ontario Planetarium and the Jasper Planetarium. For more photos from McDonald Park, visit www.wildernessastronomy.com.

CELESTIAL WONDERS

SkyNews *readers imaged another fine collection of astronomical treats: a comet, the brightest planet, some colourful nebulas and a spiral galaxy 2.7 million light-years from Earth*

▲ **THE FACE OF VENUS** The brightest starlike object in the night sky, the planet Venus owes its brilliance to its location as the nearest planet to Earth. A second factor is its dense and hazy atmosphere, which efficiently reflects most of the sunlight that illuminates it. For telescopic observers, the planet's phase is its conspicuous feature. This image was taken on October 8, 2015, by Daniel Leclerc of Pointe-aux-Trembles, Quebec, using a Sky-Watcher 8-inch Newtonian reflector telescope.

► **TRIANGULUM GALAXY (M33)** Next door to the famous Andromeda Galaxy is a smaller spiral galaxy 2.7 million light-years from Earth in the direction of the constellation Triangulum. Seen nearly face-on, M33 has low surface brightness, making it a difficult telescope target under suburban skies. In pristine conditions, however, the galaxy can be glimpsed with the unaided eye. This portrait of M33 was captured in November 2015 by Stuart Heggie from his farm near Lucknow, Ontario. The finely detailed image required a total of six hours' exposure and was recorded with an Apogee Alta U16M CCD camera fitted to a PlaneWave Instruments 12.5-inch f/8 corrected Dall-Kirkham astrographic telescope.

► **COMET CATALINA** Although this dual-tailed comet never reached naked-eye visibility from Canada, it was an interesting photographic target in December 2015. Well-known Canadian astrophotographer Jack Newton captured this composite image (three stacked 200-second exposures) from his observatory in southeastern Arizona at 5 a.m., local time, using a Meade 14-inch f/2 HyperStar with a Canon 40D at ISO 500.

CALIFORNIA ON FIRE! While California has had devastating wildfires, here we have a celestial version that only looks as if it is burning and smoking. The California Nebula (NGC1499) is a hot, glowing mass of cosmic hydrogen and dust about 1,000 light-years distant. To take this image, Lynn Hilborn of Grafton, Ontario, used a modified Canon 6D on a Teleskop Service 71mm f/5 astrographic refractor with a 12nm full-frame Hydrogen-alpha filter.

▲ **HEART AND SOUL NEBULA** Located between Cassiopeia and Perseus, near the famous Double Cluster, the Heart and Soul Nebula is about 7,000 light-years distant, which places it in the next spiral arm of the Milky Way Galaxy outward from the galaxy's core. This image was taken by Lynn Hilborn of Grafton, Ontario, with the same equipment he used for the photo at the top of this page. To see Hilborn's gallery pages, go to www.nightoverontario.com.

by Gary Seronik

The Moon's Greatest Hit

If you're wondering what the biggest feature on the lunar near side is, look no further than Mare Imbrium

GIANT LUNAR SEA Dominating the Moon's northwestern quadrant, Mare Imbrium is rich with features both impressive and subtle.

MARE IMBRIUM is a vast, roughly circular plain that spans some 1,300 kilometres—about the distance between Toronto and Halifax. Imbrium is so big that it takes four nights for the terminator to cross it. The mare is bounded on the south and east (remembering that east and west on the Moon are opposite sky directions) by the jumbled arc of the Carpathian and Apennine Mountains, while it's contained in the north by the lunar Alps. But why is Mare Imbrium circular, and what is its relationship with the surrounding terrain? To find out, we have to go back billions of years in time.

Like most large maria, Mare Imbrium is merely the tip of the proverbial iceberg. Its placid, frozen surface belies an unimaginably violent origin. When we talk of Imbrium (or, indeed, of most similar maria), we're really dealing with two features in one: an immense impact basin *and* its associated mare. Each arises from a different process separated in time by millions of years.

The story of Imbrium began with an asteroid impact on the Moon that excavated an immense basin some 3.85 billion years ago. Next, a long time following that event, magma from hundreds of kilometres below the surface flowed up through fractures in the lunar crust and began flooding the basin cavity. Unlike the thick, gooey material we see erupting here on Earth, Moon lavas had a consistency more like cooking oil and readily flowed across the

CONTRASTING COLOURS The colours of Mare Imbrium are greatly exaggerated in this image for clarity. The different hues correspond to variations in the composition of mare lavas. PHOTOS BY GARY SERONIK

lunar surface. Eventually, lavas filled the Imbrium Basin, but this didn't happen overnight or even all at once. Indeed, several episodes of flooding occurred over millions of years before the feature we now know as Mare Imbrium was completed.

Use your telescope to scan its expanse, and you'll likely notice a dearth of craters. This indicates the mare is relatively young. Because the rate of cratering has been more or less constant for the past three billion years, we know that generally, the more heavily cratered a region is, the older it is. Indeed, simple crater counting is one of the most effective tools lunar scientists have for evaluating the relative ages of different parts of the Moon's surface. That said, there are a few large craters on Mare Imbrium that are fascinating to view in a telescope. Most notable are Archimedes (82 kilometres in diameter), Aristillus (55 kilometres) and Autolycus (39 kilometres).

If you inspect Imbrium as the terminator crosses it, you'll also notice that the mare surface is not perfectly smooth —there are conspicuous undulations and wrinkles. Look again when the Moon is full, and focus your attention on differences in albedo (brightness) and colour. Subtle variations in either indicate differences in composition and age, demonstrating that the mare did not form in a single episode of flooding. For example, compare the northeastern quadrant of Mare Imbrium with the rest of the mare. If you look very carefully, you can see that the region near the Alps and south of Plato has a slightly warmer hue than the neighbouring mare. The northeastern mare consists of older lavas that date back to the late Imbrium Period, while most of the rest of the mare is from the more recent Eratosthenian Period. ✦

Gary Seronik is the editor of Antonín Rükl's Atlas of the Moon *and Charles A. Wood's* The Modern Moon. *He is a longtime fan of observing and photographing the Moon with his own backyard equipment.*

ICONIC APOLLO IMAGE OF EARTH AND MOON

Almost half a century ago, Apollo 8 astronaut Bill Anders captured this stunning portrait of Earth above the barren lunar landscape

On December 24, 1968, astronauts Frank Borman, Jim Lovell and Bill Anders were the first humans to see Earth rise above the Moon. It wasn't part of the mission plan—in fact, they almost didn't see it at all. As they orbited the Moon, they were concentrating on the lunar landscape below and on other details of the flight plan.

Anders later explained that for the first three orbits, they were pointing down, marvelling at the lunar surface, and it wasn't until after they had made a "manoeuvre to circularize our orbit at 60 nautical miles that we rolled over, going forward, [as if we were] driving a car around the Moon."

At this point, the crew was in sunlight and Anders was continuing to shoot pictures of the lunar surface. As Earth came up, Anders recalls: "I don't know who said it, maybe all of us said, 'Oh, my God. Look at that!' As the other two guys were yelling at me to give them cameras, I jokingly said, 'Well, it's not on the flight plan.' "

It was Anders who took this shot, soon coined "Earthrise," which became one of the most famous photographs of the 20th century.

IMAGE COURTESY NASA

by Ivan Semeniuk

A Trace of Methane on Mars

An ESA-led mission designed to help unravel a persistent Martian mystery is due to launch this March

HISTORY LESSON If it can confirm the presence of methane gas on Mars and pinpoint its source, the Trace Gas Orbiter will yield insights into the Martian past.
ILLUSTRATION COURTESY ESA

FOR SCIENTISTS, piecing together the story of Earth is like trying to read a long and complicated novel that's missing the first several chapters. As Livio Tornabene, a planetary geologist at Western University in London, Ontario, points out, the reason is easy to understand. Earth is unique among the solar system's rocky inner planets because of plate tectonics, the process that causes continents to drift and sections of crust to be recycled. Although Earth formed over 4.5 billion years ago, the oldest known parts of its surface are no more than about 4 billion years old. "That means there's 500 million years of missing history on Earth," notes Tornabene.

For Tornabene, this missing history is a powerful incentive to study Mars, a planet that shared many characteristics with Earth when it first formed but has since become far less dynamic. On Mars, geologists can still find tantalizing clues to a distant past.

Tornabene is among those who will be hunting for such clues as part of a new mission to Mars, which is set to launch in mid-March. Known as the ExoMars Trace Gas Orbiter (TGO), the mission is a collaboration between the European Space Agency and the Russian Federal Space Agency. It is designed to explore the hidden interior of Mars by combining analysis of surface features with measurements of the thin Martian atmosphere. A key aim of the mission is to confirm whether there is methane on the red planet and, if so, where it is coming from.

The methane story on Mars is intriguing. Methane was observed with ground-based telescopes more than a decade ago, but those results have not been definitively repeated. NASA's Curiosity rover measured no methane at all when it first checked in 2012. Later, the rover seemed to detect fleeting traces of methane in the Martian air. Skeptics wonder whether those traces somehow originated from Curiosity itself.

Because methane is easily broken down by ultraviolet light from the Sun, any methane in the atmosphere of Mars would have to be recently released. On Earth, atmospheric methane is primarily a by-product of living organisms. The gas can also be generated geochemically through the production of one or more related minerals in the serpentine group, but this process requires both heat and water. Either way, if Mars is giving off methane, it implies that there is a warm, wet environment for microbes somewhere under the surface or, alternatively, that there was such an environment in the past and the gas is now leaking out in fits and starts.

If there is methane to be found on Mars, the TGO instrument most likely to find it is the Nadir and Occultation for MArs Discovery (NOMAD). A series of spectrometers sensitive to ultraviolet, visible and infrared light, NOMAD can spot the spectral signature of methane when it peers through the Martian atmosphere toward the Sun as the spacecraft passes over the horizon or when it looks straight down at light reflecting from the surface. It should be able to not only detect methane but also measure seasonal variation and other factors that could help distinguish whether the gas is produced geologically or biologically. "NOMAD is the best instrument flown to Mars to date that can search for signs of active life across the entire planet," says Ed Cloutis, a geoscientist at

UP IN THE AIR NASA's Curiosity rover initially detected no signs of methane in the Martian atmosphere when it landed in 2012. But after more than a year, methane readings spiked for a brief period, suggesting that there may be a sporadic or seasonal source of methane hidden somewhere on the planet. COURTESY NASA/JPL-CALTECH/MSSS

the University of Winnipeg and a member of the NOMAD team.

The orbiter is also equipped with a camera that can see in visible and infrared light to help pinpoint geological features that may be associated with methane release. Tornabene, who is a member of the orbiter's camera team, has been working on how to use the instrument to spot minerals on the surface that could be linked to methane production.

Some of the oldest formations on Mars have already been tentatively linked to methane. They include Nili Fossae, a series of troughlike features with exposed serpentine and clay-rich minerals that likely formed very early in Martian history—corresponding to the missing chapters of the Earth's geological record.

TGO will reach Mars in the autumn of 2016 but will require an additional year to manoeuvre into the right orbit for its spectral observations. Tornabene can hardly wait to get started. While it's clear that the two worlds are quite different and probably always have been, he says, "Mars remains the most Earth-like planet in our solar system. I think that's what intrigues us so much." ✦

Ivan Semeniuk is a science reporter for The Globe and Mail *newspaper and website.*

SEE THE UNIVERSE LIVE AND IN COLOUR WITH

MALLINCAM

NEW! The MallinCam Micro KIT

Deluxe camera body with 2-metre wired remote control, RS485 computer socket ready, 1.25" filter-threaded adapter, DC power cable, DC 5 port cable, 0.5x focal reducer with 25mm spacer, BNC to RCA adapter, 7" colour monitor, 25' power/video cable, choice of ICX672 EXview HAD II sensor or ICX810/811 Super HAD sensor.

The new MallinCam Micro Series is a small video CCD camera capable of taking exposures from 1/100,000 second to 17 seconds, making this a versatile camera with any object viewed live on a monitor. The Micro Series camera has been custom-made to our specifications and features several improvements, such as:

- Full heat shield over the main board to keep heat away from the plastic CCD sensor to reduce hot pixels
- A 1/3-inch 960H EXview HAD II CCD sensor is included as standard equipment (a Super HAD II sensor is available)
- A complete extensive menu is available
- 700 TVL processor, through a BNC 75 ohms output

$299.99

The MallinCam SkyRaider DeepSky Series

After years of designing and testing under all operative conditions, MallinCam presents the next generation of astronomical video CCD cameras. As well as live observation, the SkyRaider DeepSky Series can take images and video recordings. Our software packages feature the most advanced live video-imaging system available.

Features:

- Handcrafted in Canada
- Up to one-hour exposure (you'll never need that long!)
- Dual independent memories for image/camera control
- Zinc aluminum alloy construction for unmatched durability
- Sealed multi-coated optical window with 350nm to 950nm range
- Full live-video mode, full-screen selectable
- Full imaging capabilities

$699.99

INTRODUCING

The MallinCam Outreach Kit

Finally, a complete, all-in-one observing system, with nothing else to buy.

This system is designed for durability on the road and has everything you need to enjoy and share the wonders of the universe. (Note: You must have a tracking telescope, as one is not included with the kit.)

Outreach Kit features:

- MallinCam Jr PRO-EX video CCD camera with Sony EXview HAD 1/2" class sensor
- MFR-5 focal reducer
- WiFi-AV transmitter
- 21.5" broadcast standard monitor in flight case (with 110VAC to 12VDC power supply)
- 12-volt cigarette lighter plug included
- No computer required
- Optional cooled video CCD camera available

Intro Price: $2,659.99

Complete kit includes MallinCam Jr PRO, WiFi transmitter, monitor, MFR-5 II, 5-amp power supply, 12-volt car adapter

Outreach Kit without WiFi transmitter: **$2,569.99**

Monitor with Flight Case: **$1,499.99**

WiFi transmitter: **$89.99**

MALLINCAM

The MallinCam XTERMINATOR

The MallinCam Xterminator is the finest, most advanced video CCD camera ever created for astronomical work by anyone. It has a new 14-bit DSP processor, dual preamps and dual bias algorithm, allowing continuous automatic adjustment of the CCD sensor regardless of the exposure. It also has the latest ICX828 EXview HAD II CCD ceramic sensor (CirDIP), available in Class 1 astronomical grade and Class 0 grade as an option. The new A/D converter to DSP has been reconfigured to deliver the cleanest image ever seen in a live video CCD camera, even with short exposure times.

Features:

- Sealed CCD chamber with 1/4" optical multi-coated glass
- High-grade argon-gas-filled sensor chamber
- New ICX828 EXview HAD II Series ceramic (Cer DIP) sensor
- Large 1/2" Micro Lens Technology CCD sensor
- Anti-dew coatings on the CCD sensor and internal optical window (a MallinCam exclusive)
- New Holtek dual preamps configuration for greater gain (a MallinCam exclusive)
- New 14-bit DSP
- New A/D converter configuration at the DSP (a MallinCam exclusive)
- Correlated double sampling (a MallinCam exclusive)
- Good suppression of CCD output low-frequency noise is achieved through the use of S/H-type correlated double sampling
- A high S/N ratio is achieved through the use of an AGC-type dual amplifier, and high sensitivity is provided by a wide cover range (a MallinCam exclusive)
- An auto offset circuit provides compensation of output DC offset voltage fluctuations due to variations in AGC amplifier gain
- New dual bias control for perfect control of the CCD sensor (a MallinCam exclusive)
- Cooling selection: OFF (idle), –5°C, –20°C via software

Starts at $1,599.99 (Xterminator 27K model)

MALLINCAM

All MallinCam products are handcrafted one at a time, making MallinCam the highest-performance CCD camera available in its class and the most-desired astronomical observational video system.

MallinCam.com

SEE THE UNIVERSE LIVE AND IN COLOUR

PROCOM ELECTRONICS, 56-5450 Canotek Rd., Ottawa, Ontario, Canada K1J 9G4

613-749-7592

Available in the U.S.: **Jack's Astro Accessories, Louisiana, USA**
http://mallincamUSA.com
Available in Canada:
Khan Scope Centre, 3243 Dufferin St., Toronto, Ontario, Canada M6A 2T2

The MallinCam UNIVERSE

The MallinCam UNIVERSE represents years of design and research in a colour CCD camera that is capable of live constant refresh with a maximum download of one second per frame. The Constant Refresh System (CRS), a first in a CCD camera, downloads a live image for full-frame review on your computer monitor. The camera acts as a video system, displaying a non-stop new image at every exposure.

The MallinCam UNIVERSE is 100% USB 2.0 controlled, and the image is also transferred through USB. A deep-cooling system with a sealed sensor chamber allows cooling to reach –45°C to ensure the lowest noise and dark current where, in most cases, a dark frame is not generally required. **A first in the industry.** Taking publication-quality images is now possible and easier than ever with this new system. A constant live image is displayed for those who wish to use the camera as a live observing system. With its super-large sensor, its total optical diagonal size of 28.4mm across and its large pixel size of 7.8 x 7.8 microns, the camera excels in delivering live colour images. The CCD sensor has a total of 6.31 mega-pixels. The sensor's horizontal size is 25.10mm, and its vertical size is 17.64mm. The active pixels (6.11 mp) deliver a total size of 3032 x 2016. The New MallinCam UNIVERSE can also be switched from colour mode to black and white with a click of the mouse.

Live processing is done on the fly using features such as full histogram adjustment, full gamma range, full contrast range and auto white balance or manual RGB colour balance.

The unique "Hyper Circuit" found on all other MallinCam systems has been incorporated into this new design, allowing the MallinCam UNIVERSE to deliver a total variable gain of 26.06+ db, a dynamic range of 80 db and a signal-to-noise ratio of 60 db.

The MallinCam UNIVERSE comes complete with a 5-metre USB cable; a 2" threaded adapter; a 1.25" converter, allowing the use of an optional 1.25" eyepiece adapter; 110 volts AC to 12 volts DC power supply; driver; and software CD-ROM.

$1,899.99

GETTING AHEAD OF HYDRA

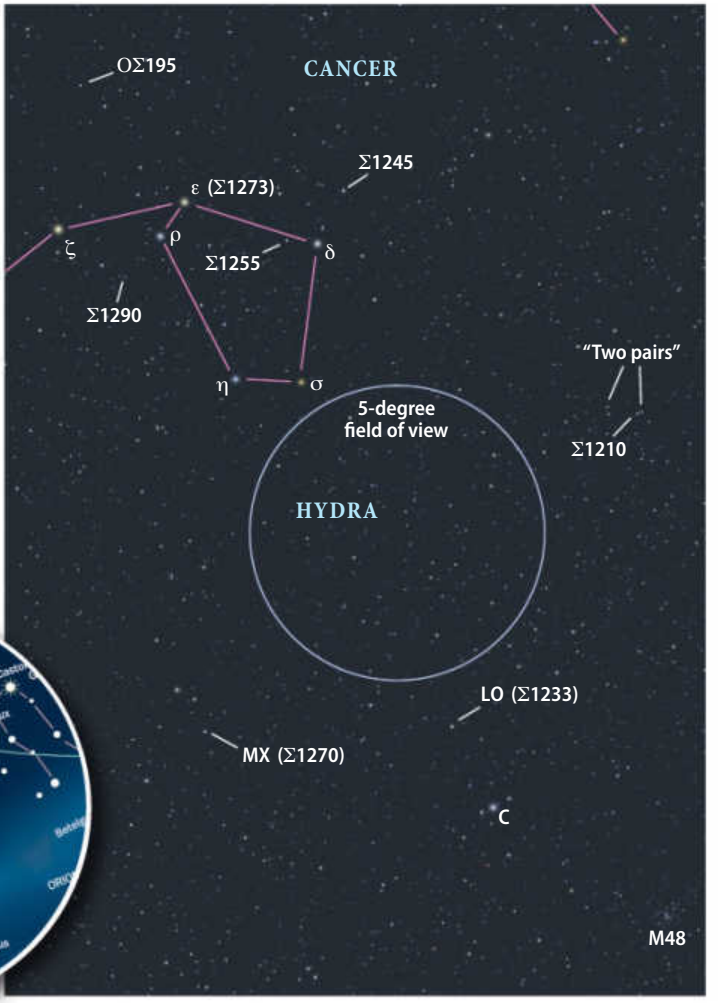
It's early spring, and Hydra has returned. Unfortunately for urban stargazers, most of the celestial water snake is submerged in light pollution. by Ken Hewitt-White

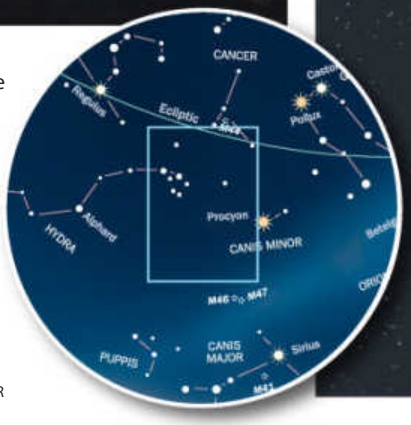
ALTHOUGH HYDRA is the sky's longest constellation, the only part that's eye-catching is the water snake's head. Outlined by a half-dozen third- and fourth-magnitude stars, the five-degree-wide asterism is easy to spot near the meridian around nightfall. It's also a region of sky worth scrutinizing with a telescope. The reason is double stars.

Accessible even to city-based telescopes, bright doubles are mostly unharmed by light pollution. Hydra's naked-eye noggin has led me to eight fine pairings—some easy, some not—that I can enjoy from my suburban yard with my 4¼-inch and 10-inch Newtonian reflector telescopes.

I began by focusing on 4.1-magnitude delta (δ) Hydrae, the westernmost star in the head of Hydra. The double catalogued as Wilhelm Struve 1255, or **Σ1255**, lies just ½ degree east of delta. I can resolve its 7.3- and 8.6-magnitude components (separated by 26 arc seconds) in my 4¼-inch scope at 27x. A prettier pair, **Σ1245**, is situated one degree north of delta Hydrae and technically resides in neighbouring Cancer. The 6.0- and 7.2-magnitude stars, 10 arc seconds apart, almost touch each other at 27x but are split cleanly at 54x. Likewise for Otto Struve 195, or **OΣ195**. This binary is also in Cancer but is a short star-hop above 3.1-magnitude zeta (ζ) Hydrae, the easternmost star in the head. From zeta, I aim 2¼ degrees north-northwest to a 6.6-magnitude star, then nudge another ½ degree northeast. The 7.7- and 8.3-magnitude points in OΣ195 are separated by 9.9 arc seconds.

A much greater challenge, halfway between zeta and delta, is 3.5-magnitude epsilon (ε) Hydrae, also known as **Σ1273**. Epsilon's 6.7-magnitude secondary star is only 3.0 arc seconds northwest of its yellowish primary. To resolve these narrowly separated, uneven components, I need my 10-inch Dobsonian working in steady con-





HYDRA RISING Despite its impressive length, Hydra is a mostly dim and obscure constellation. Ken's target region—in and around the head of Hydra—lies roughly midway between the bright stars Procyon and Regulus. Can you find the head of Hydra in the wide-angle photo above? The easiest way is to first locate the sickle of Leo, anchored by the first-magnitude star Regulus, at centre left.

MAIN CHART BY GLENN LEDREW; PHOTO BY ALAN DYER

ditions at 200x. The same setup is required for nearby **Σ1290**. To find Σ1290, I shift from epsilon south-southeast to 4.3-magnitude rho (ρ), then I continue in that direction another 1⅔ degrees to the target (it forms an equilateral triangle with rho and zeta). Slightly tighter, certainly fainter but not as uneven as epsilon, Σ1290 features a 7.4-magnitude primary and a 9.2-magnitude secondary 2.8 arc seconds away, again to the northwest. I can't crack either of these tough nuts with my smaller scope.

Now for something different. My starting point is 4.3-magnitude eta (η) Hydrae. From there, I hop westward one degree to 4.4-magnitude sigma (σ) then push 5½ degrees away from Hydra's head to reach two sets of stars separated by ½ degree. The first is a pairing of 7.7-magnitude stars nearly eight arc minutes apart, oriented north-south. The second set comprises 7.3- and 7.5-magnitude stars less than five arc minutes apart, oriented east-southeast by west-northwest. Both pairings fit comfortably in the 54x view of my smaller scope. When I examine the easternmost (7.3-magnitude) member of the second set, I can tell it's a double star. Called **Σ1210**, it has a 9.5-magnitude companion 16 arc seconds east-southeastward. A pretty field!

Two more specimens lie south of the head. A convenient landmark for locating them is 3.9-magnitude **C Hydrae**, which lies eight degrees southwest of sigma. C Hydrae plus two 5.6-magnitude flankers form a ½-degree-long row that is unmistakable in an optical finder. Several fainter stars lie in and around this three-star chain, making it an attractive low-power grouping for any scope. And if you're in the mood for a nondouble excursion, 3½ degrees farther southwest is the lovely sixth-magnitude open cluster M48.

Returning to C Hydrae, hop 1½ degrees north-northeast to the eclipsing binary **LO Hydrae**. The eclipsing components appear as one 6.4-magnitude dot, but LO Hydrae has earned the double-star designation Σ1233 due to the presence of a 10.5-magnitude attendant 18 arc seconds north-northwest. An unrelated 10.1-magnitude star lies 82 arc seconds south-southwest. Provided the sky is moonless and haze-free, my 4¼-inch reveals all three points at 93x.

Finally, drifting four degrees east of Σ1233 sweeps up another low-amplitude eclipsing binary, **MX Hydrae**. As with LO, the eclipsing components of MX appear as one. However, the seemingly single 6.9-magnitude star harbours a 7.5-magnitude companion 4.7 arc seconds westward. Together, they form a dandy double called Σ1270. My small scope splits Σ1270 nicely at 93x, while my trusty 10-inch resolves it with ease at 58x. ✦

Associate editor Ken Hewitt-White has observed deep-sky fuzzies over southern British Columbia for more than four decades.

STAR CHART *for Early Spring*

OUR CHART SHOWS the major stars, planets and constellations visible from Canada and the northern United States within one hour of these times:

EARLY MARCH: 11 P.M.; LATE MARCH: 11 P.M.*
EARLY APRIL: 10 P.M.*; LATE APRIL: 9 P.M.*

*DAYLIGHT TIME

THE EDGE OF THE CHART represents the horizon; the overhead point is at centre. On a moonless night in the country, you will see more stars than are shown here; deep in the city, you will see fewer. The ecliptic is the celestial pathway of the Moon and planets. The star groups straddling this line are known as the zodiac constellations. The Moon is shown for selected dates.

USING THE STAR CHART OUTDOORS: The chart is most effective when you use about one-quarter of it at a time, which roughly equals a comfortable field of view in a given direction. Outdoors, match the horizon compass direction on the chart with the actual direction you are facing. Don't be confused by the east and west points on the chart lying opposite their location on a map of the Earth. When the chart is held up to match the sky, with the direction you are facing at the bottom, the chart directions match the compass points. For best results when reading the chart outdoors, use a small flashlight heavily dimmed with red plastic or layers of brown paper. Unfiltered lights greatly reduce night-vision sensitivity.

CELESTIAL CALENDAR

MAR. 1 Last-quarter Moon; Moon between Mars and Saturn in morning sky

MAR. 2 Waning Moon 4° above Saturn in morning sky

MAR. 7 Thin waning crescent Moon 3° above Venus very low in dawn sky; Io and Europa shadow transits on Jupiter (evening, eastern Canada)

MAR. 8 Jupiter at opposition (at its closest and brightest; rises at sunset); new Moon, 8:54 p.m., EST; total solar eclipse (Southeast Asia and the Pacific)

MAR. 13 Daylight time begins (set clocks ahead 1 hour)

MAR. 14 👁 Io and Europa shadow transits on Jupiter (evening, all of Canada)

MAR. 15 First-quarter Moon; Mars' disc reaches 10 arc seconds in diameter

MAR. 16 Mars 10 arc minutes north of beta Scorpii in morning sky

MAR. 20 Equinox, 12:30 a.m., EDT (spring officially begins in northern hemisphere)

MAR. 21 Waxing gibbous Moon 2° below Jupiter in evening sky; Io and Europa shadow transits on Jupiter (evening, western Canada)

MAR. 22 Comet Catalina 20 arc minutes from open cluster NGC1528 in Perseus

MAR. 23 Full Moon, 7:01 a.m., EDT; penumbral lunar eclipse (visible from Canada at dawn but undetectable)

MAR. 25 Zodiacal light visible in west for next two weeks in evening sky

MAR. 28 Comet Catalina 8 arc minutes from open cluster NGC1545 in Perseus; waning gibbous Moon 4° above Mars in morning sky

MAR. 29 Waning gibbous Moon 2° above Saturn in morning sky

MAR. 31 Last-quarter Moon

APR. 7 New Moon, 7:24 a.m., EDT; Moon at close perigee (357,163 km)

APR. 8 Crescent Moon 8° from Mercury low in evening sky

APR. 9 Extreme 18.6-year tides

APR. 10 👁 Daylight occultation of Aldebaran by crescent Moon; spectacular evening event for Atlantic Canada; Moon near Aldebaran in evening sky for most of Canada

APR. 13 First-quarter Moon

APR. 16 Mars begins westward retrograde motion

APR. 17 Waxing gibbous Moon 2° below Jupiter in evening sky

APR. 18 👁 Mercury at greatest elongation from Sun (20°) in evening sky

APR. 21 Lyrid meteor shower peaks in bright moonlight

APR. 22 Full Moon, 1:24 a.m., EDT; smallest full Moon of 2016; Moon at apogee (406,250 km)

APR. 24 👁 Waning gibbous Moon, Mars, Saturn and Antares in wide grouping (rising at midnight)

APR. 29 Last-quarter Moon

👁 *Impressive or relatively rare astronomical event*

THE PLANETS

MERCURY puts in its best evening appearance of the year in mid-April, reaching its greatest angle from the Sun on Apr. 18. Look for a zero-magnitude "star" low in the west during twilight. A very thin crescent Moon sits 8° to the left of Mercury on Apr. 8.

VENUS can be seen with difficulty very low in the east during morning twilight as March opens, but it soon drops too close to the Sun to view. A razor-thin waning crescent Moon sits 3° above and to the left of Venus on the morning of Mar. 7.

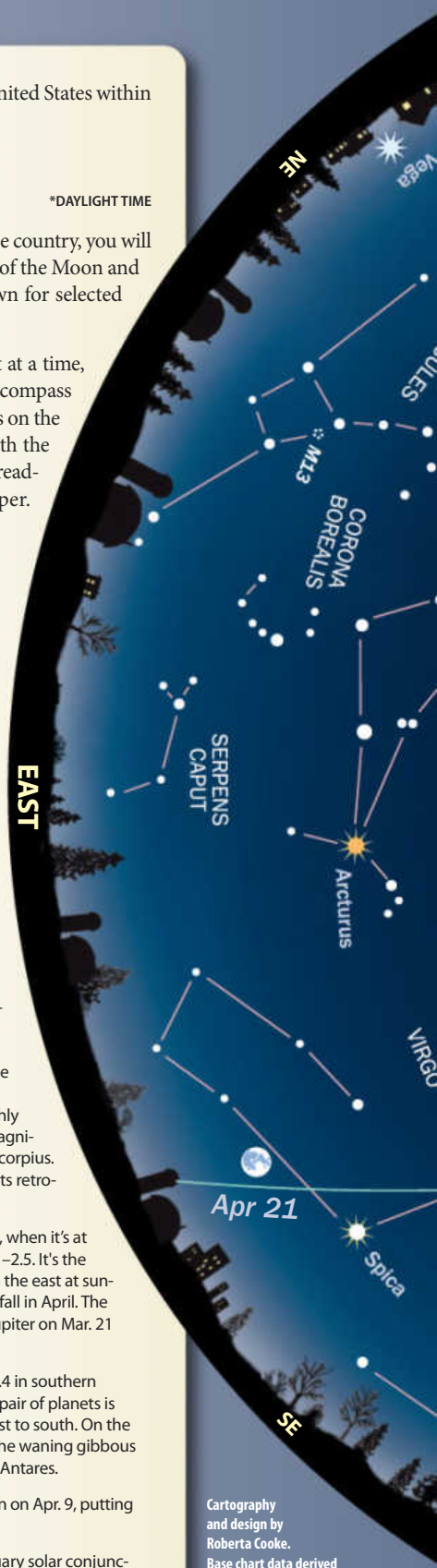
MARS rises at about 12:30 a.m., local time, in early March as an orange zero-magnitude dot on the Libra-Scorpius border. During spring, the planet rises earlier and continues to brighten as the distance between it and Earth shrinks. By Apr. 30, the red planet rises at roughly 10:30 p.m., local time, and shines at magnitude –1.5 about 5° above Antares, in Scorpius. Mars is briefly stationary, then begins its retrograde motion on Apr. 16.

JUPITER reaches opposition on Mar. 8, when it's at its brightest for the year at magnitude –2.5. It's the season's main evening planet, rising in the east at sunset in early March and well up at nightfall in April. The waxing gibbous Moon sits 2° below Jupiter on Mar. 21 and again on Apr. 17.

SATURN shines at about magnitude 0.4 in southern Ophiuchus, 7° to 10° east of Mars. The pair of planets is visible late at night low in the southeast to south. On the night of Apr. 24/25, they're joined by the waning gibbous Moon to form a wide grouping above Antares.

URANUS is in conjunction with the Sun on Apr. 9, putting it out of sight this spring.

NEPTUNE emerges from its late-February solar conjunction this spring, but it's still too low in morning twilight for easy sighting.



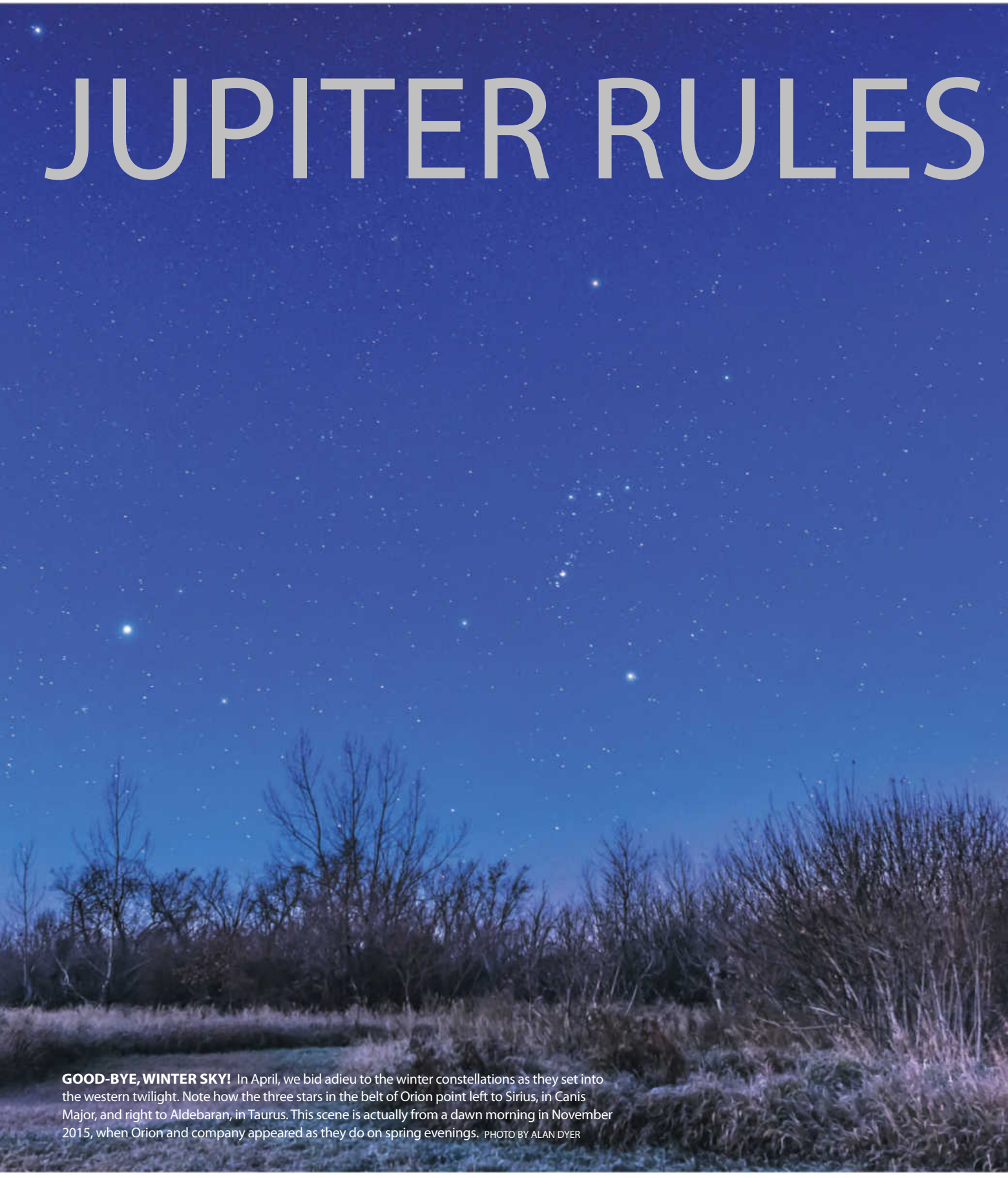
Cartography and design by Roberta Cooke.
Base chart data derived from maps drawn by Roy Bishop for the *Observer's Handbook*, published by The Royal Astronomical Society of Canada.

For more detailed information, see the *Observer's Handbook 2016*, published by The Royal Astronomical Society of Canada (www.rasc.ca or 888-924-7272).

ROTATING NIGHT SKY: During the night, the Earth's rotation on its axis slowly shifts the entire sky. This is the same motion that swings the Sun on its daily east-to-west trek. The rotational hub is Polaris, the North Star, located almost exactly above the Earth's North Pole. Everything majestically marches counterclockwise around it, a motion that becomes evident after about half an hour.

CONSTELLATIONS: The star groups linked by lines are the constellations created by our ancestors thousands of years ago as a way of mapping the night sky. Modern astronomers still use the traditional names, which give today's stargazers a permanent link to the sky myths and legends of the past.

JUPITER RULES



GOOD-BYE, WINTER SKY! In April, we bid adieu to the winter constellations as they set into the western twilight. Note how the three stars in the belt of Orion point left to Sirius, in Canis Major, and right to Aldebaran, in Taurus. This scene is actually from a dawn morning in November 2015, when Orion and company appeared as they do on spring evenings. PHOTO BY ALAN DYER

THE NIGHT

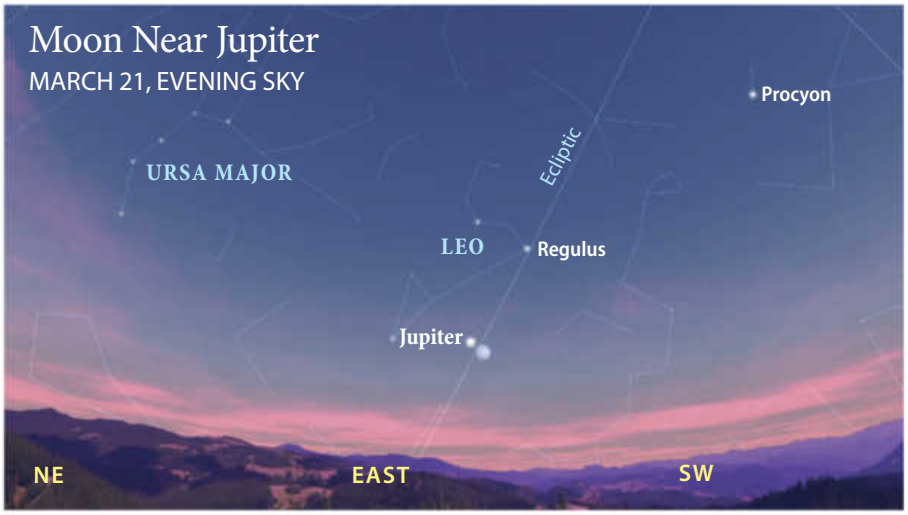
The king of the planets shines bright in the evening sky, while Mercury is at its best for 2016 *by Alan Dyer*

AFTER A WINTER with no early-evening planets, spring arrives with two in view at nightfall. Jupiter shines bright in the eastern sky as our main solar system attraction, while Mercury appears briefly in the western sky in mid-April as a prelude to its rare transit across the Sun in May. Meanwhile, in the morning sky, Mars and Saturn are close together.

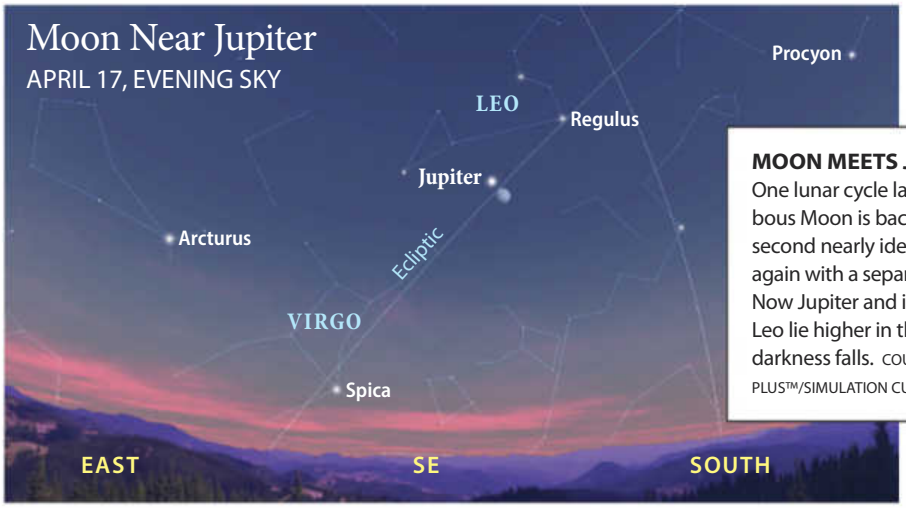
The Moon provides us with two extremes: The year's closest new Moon and the most distant full Moon both occur in April. The first raises record high tides, while the second is of interest to photographers hoping to capture 2016's smallest and largest full Moons.

JUPITER AT ITS BIGGEST AND BRIGHTEST

March and April are the prime months for exploring Jupiter this year. The planet reaches opposition on March 8, the date Earth lies directly between the Sun and Jupiter. This alignment brings us as close to Jupiter as we get in 2016, making the planet appear as big as possible in our telescopes. Opposition is also when Jupiter is positioned directly opposite the Sun in our sky. So as the Sun sets in the west, Jupiter rises in the east and lies due south at local midnight.



MOON MEETS JUPITER IN MARCH As the main planet visible these spring evenings, Jupiter shines brightly in the east beneath Leo the lion. On March 21, look for the waxing gibbous Moon positioned just two degrees below Jupiter in a fine conjunction visible low in the east at nightfall.
COURTESY STARRY NIGHT PRO PLUS™/SIMULATION CURRICULUM CORP.



MOON MEETS JUPITER IN APRIL One lunar cycle later, the waxing gibbous Moon is back near Jupiter for a second nearly identical conjunction, again with a separation of two degrees. Now Jupiter and its host constellation Leo lie higher in the evening sky as darkness falls. COURTESY STARRY NIGHT PRO PLUS™/SIMULATION CURRICULUM CORP.

A BUSY SPRING SKY The second week of April brings the waxing crescent Moon into the evening sky next to the planet Mercury (on April 8), which is beginning its evening apparition. On April 10, the Moon shines very close to Aldebaran and the Hyades star cluster, having passed in front of Aldebaran a few hours earlier, in the late afternoon or early evening, depending on your location. COURTESY STARRY NIGHT PRO PLUS™/SIMULATION CURRICULUM CORP.

As the season progresses and Earth continues along its orbit, the angle between Jupiter and the Sun decreases from 180 degrees on March 8 to 120 degrees in early May. By early June, Jupiter is at quadrature, with an angle of 90 degrees between it and the Sun. That puts the planet due south at sunset. From March 8 onward, the decreasing angle between Jupiter and the Sun means that the planet will rise a little earlier each evening, ushering in the prime Jupiter viewing season.

At opposition, Jupiter spans a generous 44.5 arc seconds, which makes seeing details on its disc easier. By May 1, it has shrunk to 40.8 arc seconds, but that's still larger than any planet except Venus, when it's closest to Earth. But unlike Venus, Jupiter offers plenty of telescopic rewards for patient observers.

JOVIAN SHADOW DANCES

March is not only opposition month but also when we get to watch several evening double shadow transits as Jupiter's inner moons, Io and Europa, simultaneously cast shadows onto the planet's cloudtops. The shadow transits occur on March 7, 14 and 21. The March 14 and 21 events are visible across the country, but the timing of the March 7 transit favours eastern Canada, while western Canada gets a better view of the transit on March 21. Easterners can see that one, too, but will have to stay up into the wee hours of March 22 to catch the entire two-hour-long show.

The most interesting of the double shadow transits occurs on March 7. Because it happens just a day before Jupiter's opposition, the moon shadows fall almost directly behind the satellites themselves, creating two close moon-and-shadow pairs marching across the disc of the planet at the same time. They are visible for 90 minutes—from 7:28 p.m. to 8:58 p.m., EST. The timing is ideal for observers in eastern Canada, but it places Jupiter too low in the sky for sharp views from western Canada. In Alberta, for example, the double shadow transit is just ending as Jupiter rises.

Because they are very dark and sharply defined, Jovian moon shadows are easy to see in even a 70mm (2.75-inch) telescope. A tougher sighting is the discs of the moons themselves. Both Io and Europa appear as small bright dots but transit the planet over Jupiter's dark north equatorial belt, which helps make the satellites easier to identify. Even so, you'll likely need at least a 100mm (4-inch) telescope to spot them.

MERCURY AT ITS HIGHEST

Our second evening planet puts in an appearance for two weeks in mid-April. That's the brief window of opportunity for sighting Mercury during the fast-moving planet's best evening-sky apparition of 2016.

Spring is the best season for seeing Mercury after sunset, as it's the only time of year when the ecliptic—the plane of the solar system—is angled steeply against the western horizon, allowing Mercury to appear relatively high in Canadian skies. At other times, the ecliptic (and Mercury) hugs the horizon. In autumn, the ecliptic is favourably tilted in the morning sky, which presents the year's second prime opportunity for Mercury viewing.

Mercury reaches greatest elongation—its widest separation from the Sun—on April 18. That's when it will be easiest to see, sitting as high in the sky and as far from the Sun as it gets. The planet glows at magnitude 0, making it conspicuous in twilight despite its low altitude. Indeed, I'm often amazed by how obvious Mercury is when conditions are right.

You can spot Mercury a week before and a week after its greatest elongation—the planet actually appears brighter before elongation. On April 8, it shines at magni-

ANNOUNCING THE 14th ANNUAL *SKYNEWS* EDITORS' CHOICE

photo of the week contest

Send us your best photos, and you could win in one of the categories below or be chosen as the overall grand prize winner.

Enter today…and every week!

See page 41 for more details.

GRAND PRIZE
Advanced VX 8-inch EdgeHD
Schmidt-Cassegrain telescope

CELESTRON
celestron.com

CATEGORY: Best digital-camera photo/lunar and planetary
Prize: SkyTracker mount, ball head, tripod and shoulder carry bag

iOptron
ioptron.com

(camera not included)

CATEGORY: Best deep-sky digital high-resolution imagery
Prize: 8-inch f/5 photo-visual Newtonian reflector OTA

Sky-Watcher
skywatchertelescope.net

CATEGORY: Best tripod-mounted unguided photo
Prize: Ritchey-Chrétien 8" telescope

MALLINCAM
mallincam.com

CATEGORY: Best deep-sky with digital SLR or webcam-type imager
Prize: 16-inch LightBridge Dobsonian telescope

MEADE
meade.com

view new Photos of the Week at

SkyNews.ca

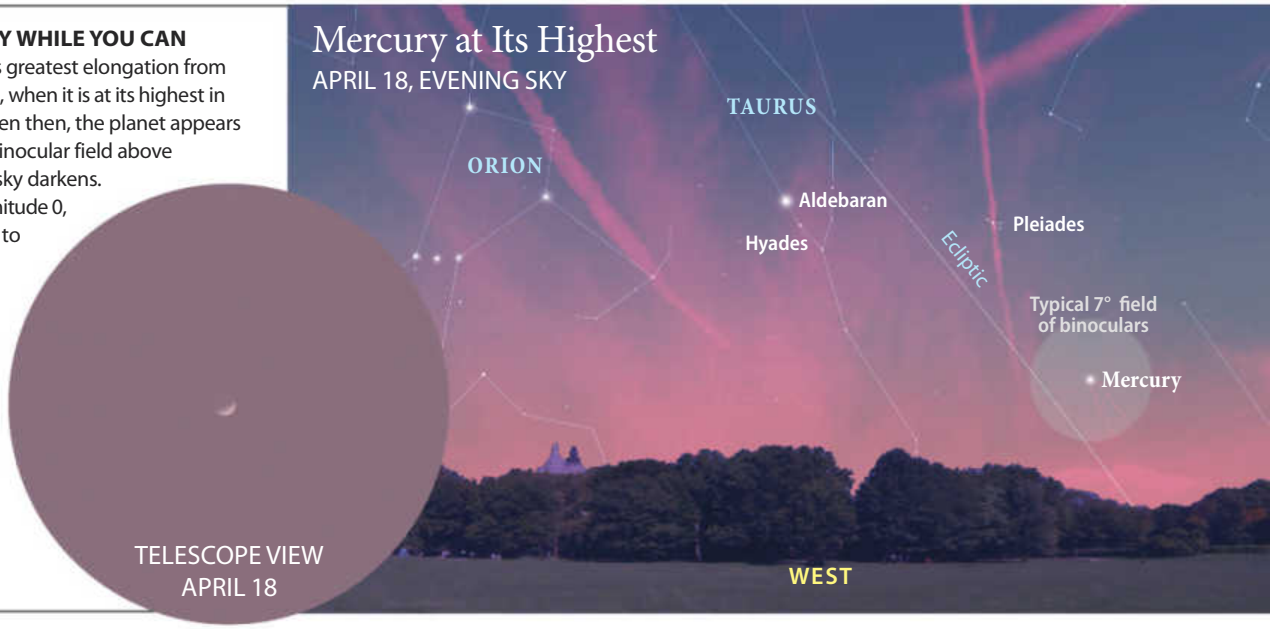
14th year of your amazing photos

Category:
Best deep-sky digital high-resolution imagery
Ron Brecher, 2015 winner

tude –1.0 and sits low in the west, roughly eight degrees (a little more than a binocular field) to the right of a thin crescent Moon. You might find Mercury the more readily visible of the two and use it to help locate the razor-thin Moon or perhaps vice versa. Either way, the pairing presents an appealing photo opportunity in a colourful twilight sky.

By April 25, a week after elongation, Mercury has dimmed to a 1.3-magnitude object, though it retains much of its altitude from the previous week. Aim a telescope at the planet, and you'll see it as a crescent resembling a tiny three- or four-day-old Moon. If you manage to follow Mercury for an additional week, which will definitely be a challenge, you'll see its phase diminish to a very thin crescent, much like the Moon appeared back on April 8.

CATCH MERCURY WHILE YOU CAN
Mercury reaches its greatest elongation from the Sun on April 18, when it is at its highest in the evening sky. Even then, the planet appears little more than a binocular field above the horizon as the sky darkens. But shining at magnitude 0, Mercury is obvious to the naked eye and brighter than any nearby star. Inset: A telescope at high magnification will reveal Mercury's thick crescent phase on April 18.
COURTESY STARRY NIGHT PRO PLUS™/SIMULATION CURRICULUM CORP.



A TRIO OF DOUBLE SHADOW TRANSITS

In March, Jupiter presents us with a series of double shadow transits at weekly intervals. All are visible in the evening sky and include Io and Europa, with both the bright discs of the little moons and their inky black shadows visible on the face of the planet at the same time.

MARCH 7, EASTERN CANADA Early in the evening of March 7, the shadows of Io and Europa fall on Jupiter from 7:28 p.m. to 8:58 p.m., EST. The event is best seen from eastern Canada; from the west, Jupiter is too low or has not yet risen when the transits are in progress. This double shadow event occurs just a day before Jupiter lies opposite the Sun, so each moon's disc lies almost directly on top of its own shadow.

MARCH 14, ALL OF CANADA A week later, Io and Europa again transit the Jovian disc together. However, a week after opposition, Earth has travelled far enough along its orbit that we now view the scene at a slight angle, creating a greater separation between the moons and their shadows. This double shadow transit runs from 10:22 p.m. to 12:34 a.m., EDT (8:22 p.m. to 10:34 p.m., MDT), making the evening sky event viewable all across Canada.

MARCH 21, WESTERN CANADA Another week later, the shadows cast by Io and Europa trail roughly 20 to 40 minutes in time behind the discs of the moons. Both shadows are on the planet from 10:23 p.m. to 12:31 a.m., MDT, favouring observers in western Canada. In the east, the transit is visible but doesn't start until 12:23 a.m., EDT, on March 22.
COURTESY THESKYX™/SOFTWARE BISQUE (ALL)

RASC GA 2016 ASTRO CATS

MAY 19–23, 2016

FOR THE FIRST TIME:

The Royal Astronomical Society of Canada

GENERAL ASSEMBLY and AstroCATS

IN THE SAME LOCATION!

HIGHLIGHTS INCLUDE:

Stan Metchev, Tina Pollman, Erika Rix, Robert Jedicke, David Levy

Impact Earth Initiative and Dresden Meteorite

Space Technology Display

Sketching Workshop

Teachers' Workshop

Helen Hogg Memorial Lecture: Ann Hornschemeier, NASA

Barbecue at the Fingal Observing Site

Programs, Panels and Presentations

THURSDAY, MAY 19
FRIDAY, MAY 20

Two-day ASTROPHOTOGRAPHY SCHOOL featuring some of the world's leading astrophotographers: Chris Go, Ken Crawford, Warren Kellar, Richard Wright, Doug George and Ron Brecher

SATURDAY, MAY 21
10 A.M.–6 P.M.

SUNDAY, MAY 22
10 A.M.–4 P.M.

AstroCATS EXHIBITORS:

New additions, including some "big-name" manufacturers, plus many of last year's exhibitors will be back.

Even more door/raffle prizes (last year's prizes $23k), plus a Silent Auction for big-ticket items!

Hosted by RASC London and Hamilton Centres

FANSHAWE COLLEGE, LONDON, ONTARIO

For more information, please contact:

rasc.ca/ga OR astrocats.ca

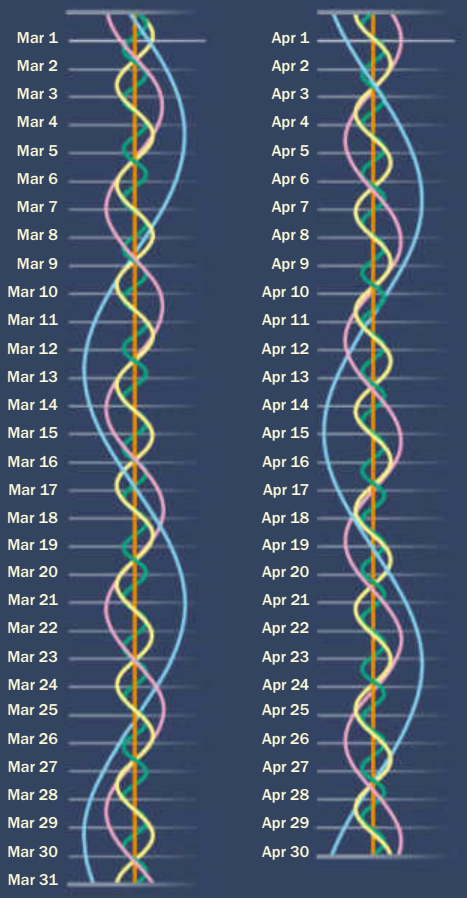
JUPITER'S MOONS

March and April 2016

The positions of Jupiter's four largest moons are shown for each night of the two-month period. Jupiter is represented by the central vertical shaft, while the moons are the four wavy lines. The horizontal lines mark 8 p.m., EDT, on the dates indicated. Time flows from top to bottom, so look proportionately below the line for later times on a particular date. East is to the left, and north is at the top, as seen in binoculars. From closest to farthest, the moons are Io, Europa, Ganymede and Callisto. Orbital periods are 1.8, 3.6, 7.2 and 16.7 days, respectively.

KEY:

Io Europa Ganymede Callisto



PRELUDE TO A TRANSIT

When Mercury's orbit carries it between us and the Sun, it's said to be at inferior conjunction. Of course, sitting so close to the blindingly bright solar disc, the planet usually can't be seen. Usually? We can see Mercury at inferior conjunction only if it happens to pass directly in front of the Sun.

When the Moon drifts across the Sun, we call the event a solar eclipse. On the rare occasion when Mercury does the same thing, we call it a transit. And this year, for the first time since November 2006, Mercury will transit the Sun as it passes through inferior conjunction on May 9. We'll see the planet as a tiny black dot for 7½ hours as it slowly crosses the solar disc.

All of Canada will get to see this special phenomenon, though from the west the Sun rises with the transit already under way. I'll have more details in the next issue, but for now, mark the date. In the meantime, as a pretransit treat, keep an eye on the planet through April as it descends the evening sky toward its daytime rendezvous with the Sun on May 9.

VENUS VANISHES

Brilliant Venus dominated the morning sky over the past five months but is now essen-

ALDEBARAN OCCULTATION

The Moon passes in front of Aldebaran at monthly intervals this year, but most of these occultations are not visible from Canada or, as on April 10, occur in daylight. That doesn't mean you can't see the event. If your afternoon sky is very clear and transparent and if you can locate the Moon, Aldebaran should be visible in a telescope as a sparkling jewel near the lunar disc. The star will disappear behind the dark limb of the Moon and reappear from behind its bright limb. From Atlantic Canada, Aldebaran reappears in spectacular fashion in a twilight sky.

SPECTACLE FROM ATLANTIC CANADA If you live in Atlantic Canada, mark April 10 on your calendar for a superb occultation. From the East Coast, the event occurs late enough that the disappearance of Aldebaran happens at sunset and the reappearance occurs about an hour later, as the sky darkens. This will provide a stunning naked-eye sight of the bright star suddenly winking into view beside the crescent Moon. The rest of Canada must settle for seeing the Moon shining well east of Aldebaran at nightfall.

COURTESY STARRY NIGHT PRO PLUS™/SIMULATION CURRICULUM CORP.

LOCATION	ALDEBARAN DISAPPEARS (INGRESS)	ALDEBARAN REAPPEARS (EGRESS)
HALIFAX	8:00 P.M., ADT*	8:56 P.M., ADT**
MONTREAL	6:47 P.M., EDT	7:48 P.M., EDT
TORONTO	6:39 P.M., EDT	7:46 P.M., EDT
WINNIPEG	5:17 P.M., CDT	6:13 P.M., CDT
EDMONTON	4:12 P.M., MDT	5:36 P.M., MDT
VANCOUVER	2:48 P.M., PDT	3:28 P.M., PDT
	* AT SUNSET	** ONE HOUR AFTER SUNSET

tially lost in the bright twilight glare. It's heading toward superior conjunction, when it is positioned directly opposite Earth on the other side of the Sun on June 6.

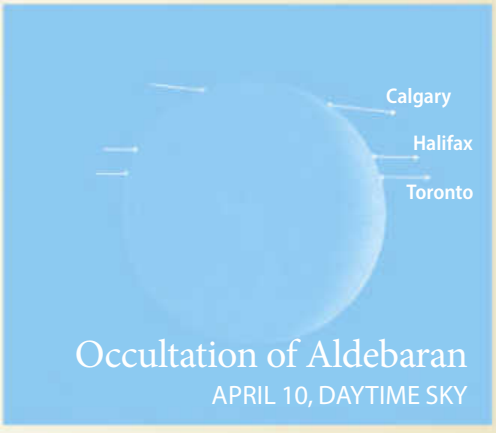
You might catch a last glimpse of Venus just before sunrise on March 7, when the thin waning crescent Moon lies just three degrees from the planet. But this will be a very difficult sighting from Canadian latitudes. Don't expect to see Venus again until late summer, when it reappears in the evening sky.

MARS AND SATURN TOGETHER

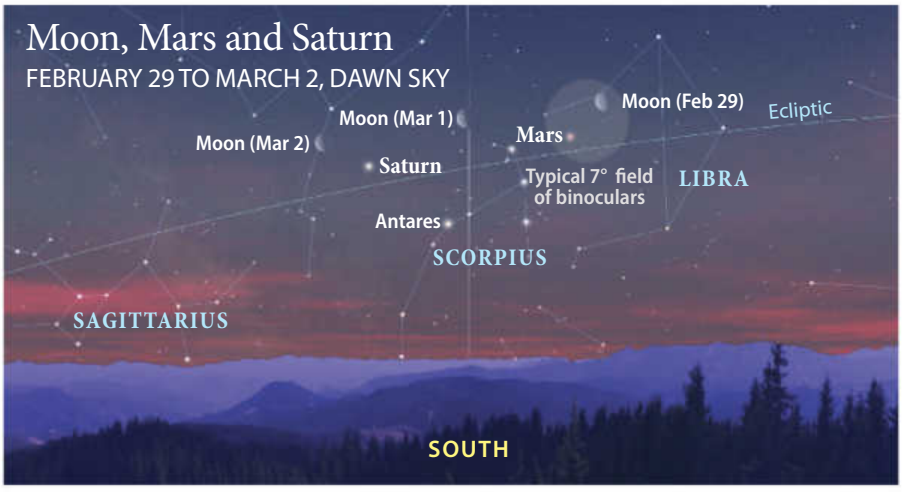
The morning sky is home to Mars and Saturn. They're within about 10 degrees of each other just above Antares, the brightest star in Scorpius. Mars officially lies across the border in Libra until March 13, when prograde (eastward) motion carries it into Scorpius.

Saturn looks as if it's in Scorpius, but it actually sits in southern Ophiuchus the serpent bearer, one of only three non-zodiac constellations to play host to planets (excluding Pluto, which sadly no longer counts as a planet). Can you figure out what the other two constellations are?

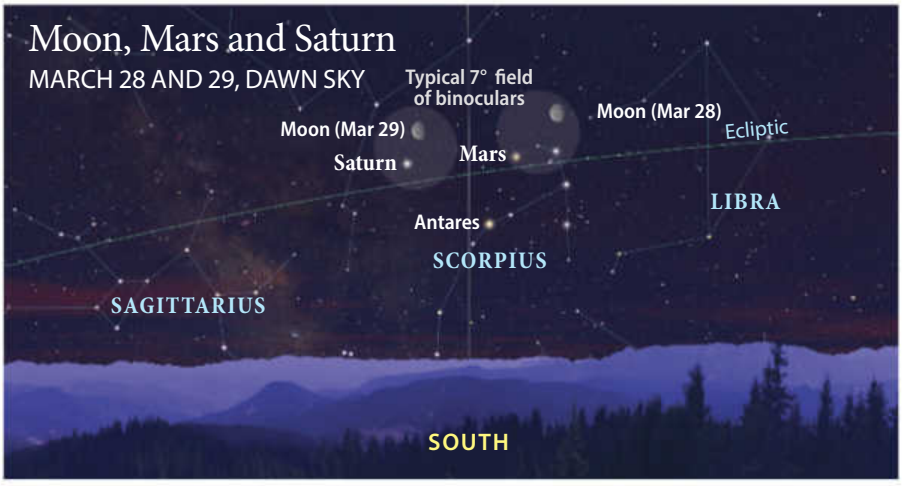
While Mars and Saturn rise earlier each morning, they won't be up until after mid-



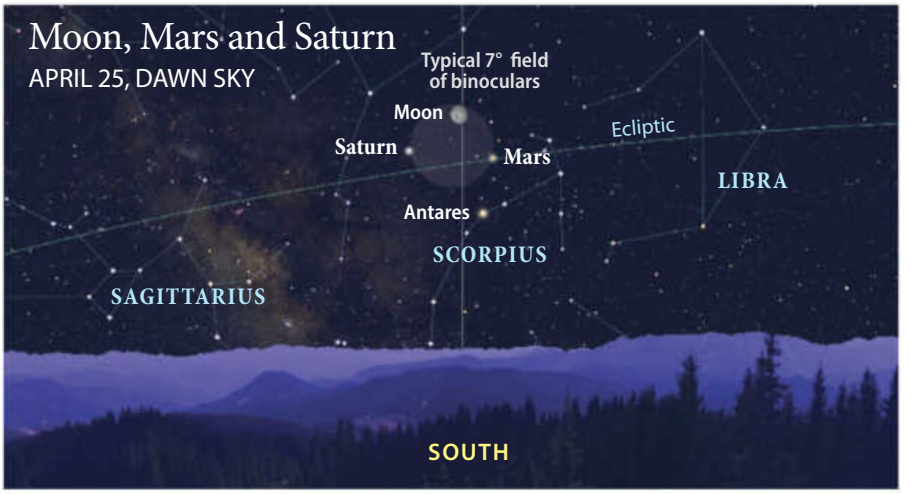
DAYTIME DISAPPEARANCE All of Canada can see this daylight occultation, with Aldebaran slipping behind the northern part of the lunar disc, as seen from western Canada. Use a telescope at low power, and prefocus it the night before on a star or in daylight on a very distant object. If the telescope is even a little out of focus, seeing the pale Moon in a bright blue sky will be difficult. Only on the East Coast does the event occur at sunset. COURTESY THESKYX™/SOFTWARE BISQUE



MORNING MEET-UP #1 Mars shines west of Saturn all spring, with both worlds positioned above the red supergiant star Antares, in Scorpius. At dawn on March 1, look due south for the last-quarter Moon sitting halfway between the two planets, about eight degrees from each one.



MORNING MEET-UP #2 At the end of March, the Moon returns to Scorpius for a second encounter with Mars and Saturn. On March 28, the waning gibbous Moon shines four degrees above Mars. The next morning, March 29, the lunar disc sits just two degrees above Saturn. Mars and Saturn are now separated by nine degrees. COURTESY STARRY NIGHT PRO PLUS™/SIMULATION CURRICULUM CORP. (ALL)



TRAFFIC JAM IN SCORPIUS A month later, on the night of April 24/25, the waning gibbous Moon is back above Mars and Saturn to form a seven-degree-wide triangle of worlds clustered a single binocular field above Antares. The gathering rises about midnight on April 24 and lies due south, as shown here, between 3 a.m. and 4 a.m., local time, on April 25.

night for most of the season. For the best views, plan to catch them at dawn, when they shine due south.

On March 16, three mornings after it crosses into Scorpius, Mars passes just 10 arc minutes north of the star beta Scorpii (magnitude –2.5), also known as Graffias. On that date, Mars will be at magnitude 0, far outshining Graffias. Nevertheless, the two should make a fine faux double star in a telescope, as red Mars contrasts with blue-white Graffias, itself a superb double star.

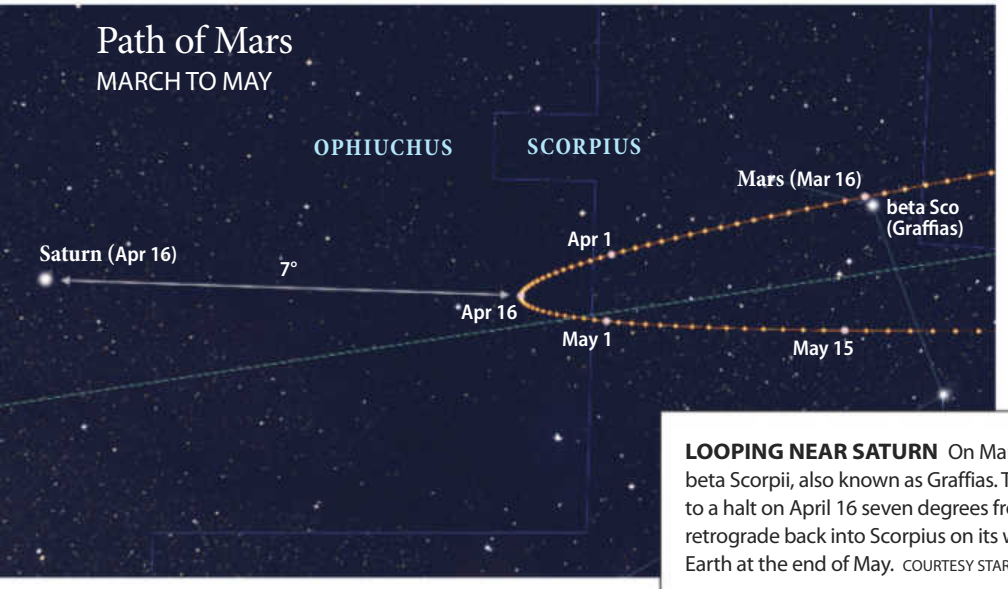
On March 15, Mars passes a milestone in its 2016 apparition when its disc finally reaches 10 arc seconds in apparent diameter. That's still pretty small, but it is large enough for experienced observers to begin to see hints of detail on the Martian disc.

RED PLANET RETROGRADING

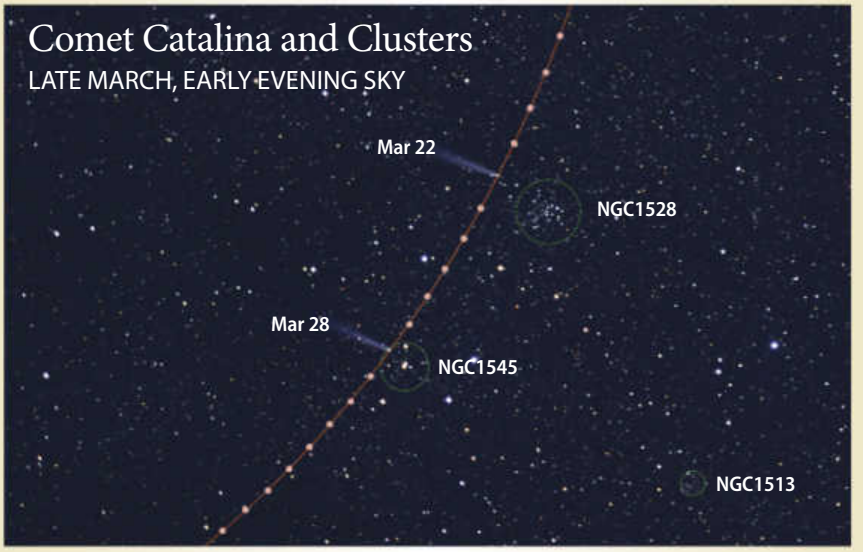
Mars is getting larger and brighter as Earth approaches it. The red planet's 2016 apparition promises to be a decent one. Mars reaches opposition on May 22, when it rises at sunset and shines at magnitude –2.0, second only to Jupiter in brilliance. Mars is closest to Earth a week later, on May 30, when it presents a disc 18.6 arc seconds across—its largest apparent size since 2005. That's the good news. The bad news is that from Canadian latitudes, Mars will be low in the sky, where the blurring effects of our atmosphere make sharp telescopic views a challenge. (I'll have more to say about Mars in the next issue.)

For now, you can follow Mars with your unaided eye as it meanders in Scorpius. After its encounter with Graffias, Mars continues to trek eastward until April 16, when it's temporarily stationary, parked in Ophiuchus. Mars then begins to retrograde westward back into Scorpius. Retrograde motion is a trick all superior planets (that is, planets lying farther from the Sun than Earth) perform for a few weeks on either side of opposition. The effect is the result of the Earth's overtaking the slower-moving outer planet.

In mid-April, Mars has its closest approach to Saturn and is as far east as it gets this spring. Look for the red planet about seven degrees west of Saturn, with the ringed planet at magnitude 0.3, dimmer than Mars, which by then has brightened to magnitude –1.



LOOPING NEAR SATURN On March 16, Mars passes just 10 arc minutes north of beta Scorpii, also known as Graffias. The red planet continues eastward until it comes to a halt on April 16 seven degrees from Saturn, in Ophiuchus. Mars then begins to retrograde back into Scorpius on its way to opposition and its closest approach to Earth at the end of May. COURTESY STARRY NIGHT PRO PLUS™/SIMULATION CURRICULUM CORP.



COMET CATALINA PHOTO OPS

By March, Comet Catalina will have faded to an unimpressive magnitude 10. However, the comet passes very close to two bright star clusters in Perseus: NGC1528 on March 22 and NGC1545 on March 28. Despite the comet's faintness, the Moon is out of the way, and both evenings provide fine photo ops for deep-sky imagers favoured with dark skies. COURTESY STARRY NIGHT PRO PLUS™/SIMULATION CURRICULUM CORP.

A PERIGEE NEW MOON

The Moon presents us with a pair of extremes in April. On April 7, we have the closest new Moon of the year—a perigee new Moon lying 357,163 kilometres from Earth. The combination of the Moon's proximity and its position between Earth and the Sun is sufficient to raise higher than normal tides along coastal regions. But as Roy Bishop explained in the 2015 edition of the RASC *Observer's Handbook*, two other factors conspire to produce record high tides in April. On April 7, the new Moon and the Sun also lie near the celestial equator and the spring equinox point. This increases the tidal influence of both bodies to produce a higher than normal tide—a tide that occurs at new or full Moon at any time of year, not just in spring.

A similar geometry occurred last September 28, the night of the total lunar eclipse.

RISING TIDE April 9 should bring a record high tide to the shores of the Minas Basin in Nova Scotia, home to some of the highest tides in the world. In August, the author was a guest of Roy Bishop, tide expert and contributor to the RASC *Observer's Handbook*. This image is a single frame from a time-lapse sequence showing the incoming tide about to engulf an unsuspecting sunbather. For the time-lapse movie, see https://vimeo.com/136883192.

MOONS BIG AND SMALL The full Moon on April 21/22 occurs when the Moon is at apogee and at its greatest distance for 2016, which makes it the smallest one of the year. Contrast that with the perigee full Moon of November 13/14, which will be the nearest and largest of 2016 and the biggest until 2034. The difference in size is difficult to perceive except in illustrations like this one.
ILLUSTRATION PHOTO BY GARY SERONIK

At that time (and for the day or two following), coastal areas experienced their highest tides in 18 years. Similarly high tides are expected again in the day or two following the April 7 new Moon, with a record high tide predicted for April 9, for example, in the Minas Basin in Nova Scotia.

Enjoy the high tides in April. They will not be repeated until the cycles of the Sun and Moon align the same way again in 2034.

AN APOGEE FULL MOON

Two weeks after perigee, the Moon is at apogee—the farthest point in its orbit around Earth. On the night of April 21/22, when the Moon is full, it lies 406,250 kilometres from Earth. (The exact moment of apogee occurs half a day earlier, on the morning of April 21 for North America.)

This makes the April full Moon the most distant and, therefore, the smallest of 2016. By comparison, the next time the Moon is full, on May 21, it is 402,700 kilometres away, a hairsplitting 3,550 kilometres closer.

Nevertheless, if you want to photograph the biggest and smallest full Moons of 2016, mark April 21 on your calendar. To complete the set, however, you'll have to wait until the November 14 perigee full Moon. That will also be the closest perigee full Moon until—just like the tides—2034. ✦

PERSEIDS ON THE RUN

A dedicated team of Ottawa meteor observers hit the road in a car filled with camera gear and high hopes *by Pierre Martin*

METEOR AFTERGLOW The brightest Perseid in this image is a magnitude –4 streak that appears slightly odd because the camera missed the meteor's initial flash but captured its bright bluish afterglow. A faint greenish aurora, mixed with thin clouds in the distance, is also visible above the trees. In all, 110 meteors are recorded in this composite of more than one hundred 20-second exposures taken with a Canon EOS 5D DSLR camera at ISO 1600 equipped with a 50mm f/1.4 lens set to f/2.2. PHOTO BY PIERRE MARTIN

THE 2015 PERSEID METEOR SHOWER promised to be exceptional. The timing of the display's peak, in the predawn hours of August 13, was nearly ideal for observers in North America. Not only would the sky be free of moonlight, but some experts predicted unusually high levels of Perseid activity. The only wild card was the weather.

Even in summer, the Ottawa region is often challenged by a variety of poor weather conditions. This time, it was clouds from a large low-pressure system stalled over Quebec. Despite the grim outlook, forecasts predicted favourable conditions to the southwest, toward Georgian Bay and Lake Ontario. So on the afternoon of August 12, Raymond Dubois, Shane Finnigan and I loaded the car with camping gear and photography equipment and made a run for it.

After we drove for four hours under agonizingly persistent cloud cover, the sky gradually began to look more promising. But the Sun was getting low—we'd have to pick our observing spot soon. We stopped to look at the road map and made our decision: Balsam Lake Provincial Park. A short time later, as we pulled into the park entrance, we were greeted by a deep blue, crystal-clear sky. We were ecstatic.

The three of us quickly set up our equipment on a grassy patch in a large wide-open parking area, just steps away from the beach. As dusk settled, meteors were already flying overhead, including several bright Perseids sporting long trails. All around us, we could hear cries of excitement and delight from neighbouring campers. And this was only the beginning.

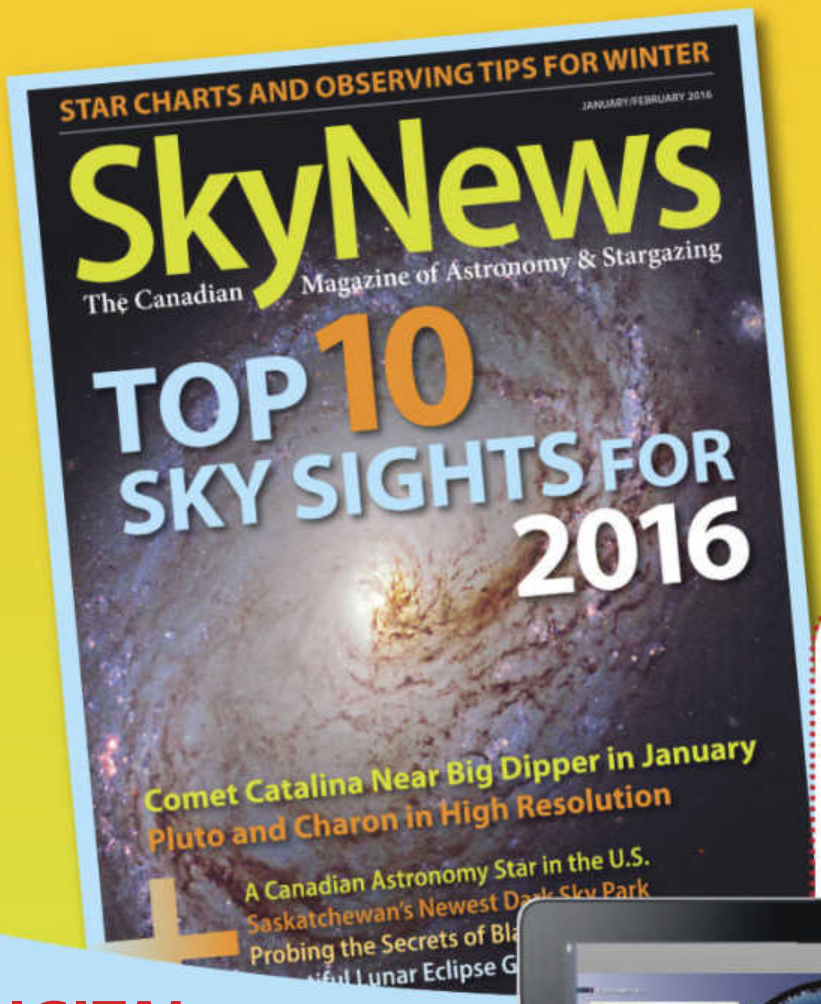
It turned out to be an exceptional night. Perseids streaked across the sky thick and fast. A blue-green fireball flashed in the north, leaving a prominent train that lasted several seconds—a sight nicely captured by one of my cameras. And while the photographic equipment carried on, I began my meteor count in earnest. As the hours passed, the Milky Way arching high overhead provided a spectacular backdrop for the meteor show. I counted 110 meteors, including 93 Perseids, in the busiest hour, from 2:40 a.m. to 3:40 a.m. The single most spectacular meteor was a dazzling magnitude –6 fireball, complete with terminal flash and a train that persisted for 30 seconds. All told, I counted 371 meteors (309 of which were Perseids) in just over four hours of viewing.

A beautiful setting, excellent conditions and the company of good friends made the 2015 Perseids a shower to remember. ✦

Pierre Martin is an experienced meteor observer and photographer based in Ottawa.

PERSEIDS APLENTY Aimed toward the shower's radiant, near the famed Double Cluster in Perseus, the camera captured 99 Perseids in this composite photo. The fuzzy disc-shaped haze midway along the right edge of the frame is the Andromeda Galaxy. This image was created by combining 30-second exposures recorded with a Canon EOS 6D DSLR camera set to ISO 1600 and a Sigma 35mm f/1.4 Art lens set to f/2.2. A single 2.5-minute exposure at ISO 800 and f/4 was used for the background star field.
PHOTO BY PIERRE MARTIN

Subscribe Now!



PRINT EDITION

1 year (6 issues) for only $26

SAVE $10 off the cover price

To order, simply complete the card opposite, call toll-free **1-866-759-0005** or visit us at **skynews.ca/order2016**

SUBSCRIBE TO WIN

a LightBridge 12" Dobsonian with premium components and ultra portability from Meade.

A $1,300 retail value.

MEADE INSTRUMENTS

DIGITAL SUBSCRIPTIONS

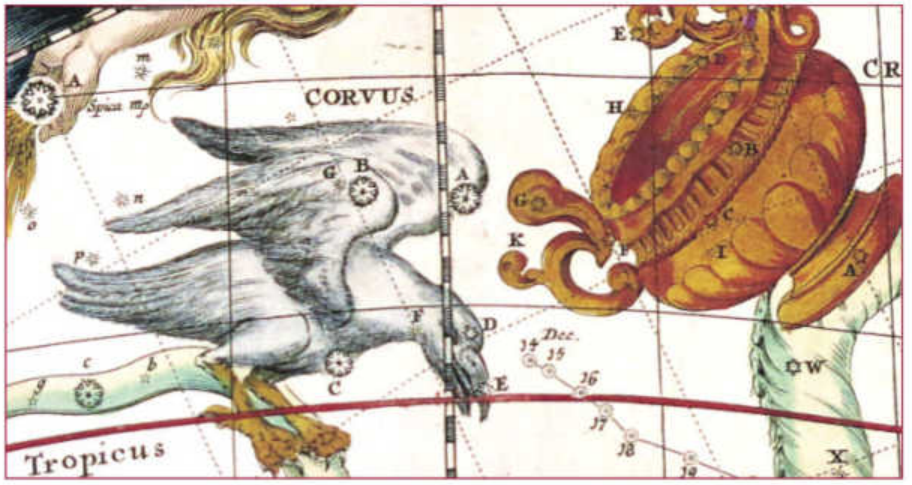
Enjoy anywhere, anytime access to SKYNEWS Digital Edition. Includes Exclusive Online BONUS: access to 10+ years of SKYNEWS back issues to search and browse for FREE.

Visit skynews.ca/digital2016

SkyNews
The Canadian Magazine of Astronomy & Stargazing

CORVUS AND CRATER

Most mythological characters were elevated to the sky as a reward. Not so, the poor old crow. *by Ken Hewitt-White*



BALANCED on the writhing coils of Hydra the water snake, the adjacent constellations Corvus the crow and Crater the cup are linked by an engrossing parable.

One day, the Greek god Apollo dispatched his servant Corvus with a sacred chalice to fetch water. The bird got distracted, however, and returned quite late. In his defence, the crow spun a yarn about being attacked by a water snake, whose remains he held in his claws. Apollo didn't buy it. In a spiteful fury, he cast a spell of unquenchable thirst on Corvus, then flung the bird, chalice and reptile into the sky. Corvus discovered that his heavenly perch was just east of the brimming cup of water, but the westward drift of the heavens keeps the prize forever out of reach. Hydra is coiled nearby to guard the chalice, just in case.

Poor Corvus didn't fare very well in any legend in which he appeared. In Roman times, the Latin poet Ovid wrote that when Corvus dutifully reported the unfaithfulness of Apollo's wife, the god threw a fit, turning the crow's silvery plumage to black and imprisoning him in the underworld.

Corvus earned higher marks in another myth as Noah's raven flying bravely over the biblical flood. Alas, he still suffered an undignified end. As no dry land was in sight, Corvus had to make a forced landing on his old foe Hydra.

In Chinese lore, we see the group's classical roles reversed. Corvus is depicted benignly as a cart, while Crater is the dreaded Heavenly Dog, a hound of horror whose malevolent influence prevented the birth of sons.

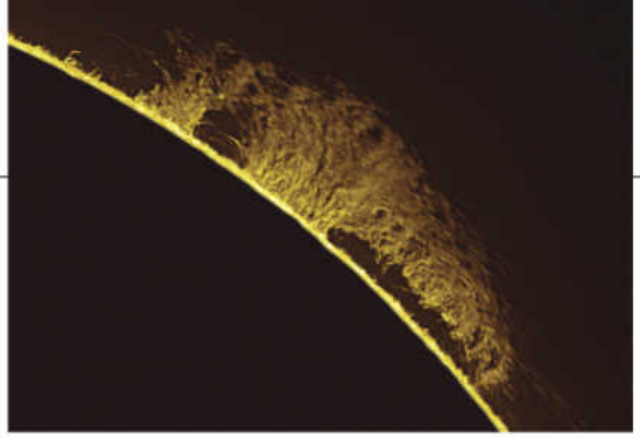
To modern observers, Corvus and Crater are an obscure odd couple. Corvus's boxy star pattern is small and not at all birdlike, yet it's moderately bright. Its four principal stars, each magnitude 3, are easy to spot southwest of first-magnitude Spica. By contrast, the eight stars of Crater are hard to identify in a suburban sky. All but one is dimmer than magnitude 4.0, but those faint points do outline an enticing celestial goblet—just ask the crow.

Another oddity about these neighbours is that their "alpha" stars, named Alchiba (alpha Corvi) and Alkes (alpha Crateris), are hardly leading lights. Alchiba, magnitude 4.0, ranks fifth in Corvus. Alkes, magnitude 4.1, is tied for second in Crater. ✦

COSMIC VISTAS

Here's another selection of celestial wonders captured by our photographically oriented readers

▼ PLEIADES CLUSTER *VERY* LONG EXPOSURE
Arguably the night sky's most beautiful star cluster, the Pleiades (M45) is a magnificent sight in binoculars or any small telescope. But in long-exposure images, such as this outstanding example by Dan Posey, it morphs into a magical cloud of jewels embedded in nebulous mist. This digital stack of 62 five-minute exposures was taken with a Canon 6D DSLR camera on a Tele Vue 127mm Petzval refractor operated by the RASC Victoria Centre.



► **SOLAR HEDGEROW** Specialized filters are necessary to view the blindingly bright disc of the Sun and appreciate features like this solar prominence, captured by Sherbrooke, Quebec, imager Daniel Brousseau on September 17, 2015. Brousseau used a ZWO ASI120MM-S monochrome video camera to record the output from a DayStar QUARK H-alpha filter "eyepiece" (chromosphere model) attached to a Celestron Omni 120mm refractor.

▲ **GEMINID METEOR SHOWER** The most active meteor shower of 2015 occurred on December 13/14 during an extraordinarily cloudy month over most of Canada. Faced with the bleak forecast at home, Ontario astrophotographer Malcolm Park travelled to southwestern New Mexico, where he found excellent conditions for this 50-shot composite image taken with a Nikon D3S and a 14-24mm lens at 14mm and f/2.8.

◄ **JUPITER'S MOON IO AND ITS SHADOW** With its family of four large moons and distinctive cloud belts, the solar system's biggest planet is one of the premier targets for amateur astronomers' telescopes. This image showing the Great Red Spot and the Jovian moon Io, along with its shadow on the planet, was taken on November 10, 2015, by Daniel Leclerc from his backyard in Pointe-aux-Trembles, Quebec, using a Sky-Watcher 8-inch Newtonian reflector.

ASTROMART

by Ken Hewitt-White

Delights at Dawn

With a writing assignment due, Ken sets his alarm for the wee hours

BEEP! BEEP! BEEP! My digital alarm clock was waking me up at 3 a.m.—again. Lousy weather last autumn forced me into that predawn routine a dozen times as I tried to explore the head of Hydra for my "Scoping the Sky" column (see page 22).

My "Scoping" articles are mainly about deep-sky objects visible from the average suburban yard. If I can see it in the light-blighted sky above my backyard, it goes into the column. I usually complete my observations in the evening a year before the issue is published. Sometimes, though, I come up with an idea just a few months prior to publication. In that case, my target doesn't rise until after midnight, so I have to drag myself out of bed when the object climbs high enough for me to get a good look in my telescope.

Sleep deprivation aside, I don't mind the wee hours because that's when my local observing conditions are most tolerable. At nightfall, I have to deal with unshielded porch lights, interior lamps glaring through naked windows and (my pet peeve) the exterior "mood" lighting that illuminates a bungalow on the other side of the back alley. Fortunately, a timer switches off the glow at 11 p.m. But it returns at 5 a.m., when those fine folks get up for work. The neighbours flanking them are likewise early risers. Their departing cars trigger every motion-sensor security light in the neighbourhood.

Avoiding all that "rise and shine" was almost crucial to the successful completion of my Hydra project. Would the target area climb high enough in the southeast before my yard got bathed in unwanted photons? Yes, but not until at least mid-October. Another complication was the Moon. It would start to brighten the sky in late October and then again during the last week of November. The deadline for my column was November 27. All I needed was one good morning—no clouds, no moonlight, no house lights—sometime before the deadline date.

BRIGHT PLANETS Venus, Jupiter and Mars were arranged in a tidy triangle in the morning sky on October 26. Venus is brightest, with Jupiter just above it. Mars is the orange dot slightly below and to the left of the dazzling pair.
PHOTO BY MALCOLM PARK

Naturally, the weather was terrible. A promising sky at bedtime nearly always clouded over before dawn. On one otherwise unblemished morning, a solitary band of haze persisted in the southeast. On another, the sky was technically clear but too misty for good scoping. Several times, I waited under broken cloud to no avail. And I lost two clear skies to powerful winds. Hydra, though, was rising earlier every night. After standard time returned on November 1, I knew I could complete my work before the 5 a.m. lights-on hour. Finally, I got not just one calm, clear morning but two: November 10 and 20. To my great relief, I was able to scope everything on my list. Mission accomplished!

But that wasn't all. My predawn perseverance was rewarded by some terrific views of a long-lasting planetary configuration. The showcase alignment involving Venus, Jupiter and Mars had been promoted in this magazine. By late October, the planetary trio had gathered beneath the hindquarters of Leo the lion, where, as advertised, they formed a conspicuous triangle less than five degrees wide. My 7x50 binoculars captured all three planets, plus a half-dozen fairly bright stars, in a single field. It was a dazzling, one-week-only "supercluster."

The planets slowly parted yet remained eye-catching for a month. Just before dawn on November 20, I traced a virtually straight line from Regulus and Jupiter in Leo down to Mars and Venus in Virgo. Five medium-bright stars along the way enhanced the linear effect. Moreover, each planet had a stellar companion. Jupiter partnered with sigma Leonis, Venus blazed near gamma Virginis, and the red planet Mars paired closely with pure white eta Virginis. Lovely!

That long line-of-nine spanned 43 degrees. A tenth star—Spica, near the southeast horizon—bent the alignment but stretched it out to 54 degrees. And even more amazing, I witnessed the spectacle in a relatively dark setting. The Moon had set, twilight had yet to begin, and my neighbours had departed. Every motion-sensor light had switched off. Ah, perfect! ✦

Associate editor Ken Hewitt-White observes the night sky from the mountains of British Columbia.

ORION®

CELEBRATING 40 YEARS

EVERYTHING FOR THE AMATEUR ASTRONOMER

For 40 years and counting, our commitment to quality, service and support has made Orion your one-stop source for affordable amateur astronomy gear.

Orion® 60mm Multi-Use Guide Scope with Helical Focuser
#13008 **$219.99**

Orion® Sirius Pro AZ/EQ-G Computerized GoTo Telescope Mount
#10088 **$1599.99**

NEW PRODUCT 2015

Orion® StarSeeker™ IV 150mm GoTo Reflector Telescope
#13161 ~~$579.99~~

Orion® Ritchey-Chrétien Astrograph Telescopes
6" #8268 **$499.99**
8" #8267 **$999.99**
10" #8266 **$2799.99**

Orion® StarSeeker™ IV 130mm GoTo Reflector Telescope
#13160 **$499.99**

Orion® StarSeeker™ IV 127mm GoTo Reflector Telescope
#13163 **$699.99**

Orion® 40th Anniversary SkyQuest™ XT8 Dobsonian Telescope
#9702 **$499.99**

Orion® EON™ 115 ED Triplet Apochromatic Refractor Telescope
#10087 **$1,799.99**

Orion® SkyQuest™ XT8 PLUS Dobsonian Reflector
#8974 **$529.99**

Orion® GoScope II™ 70mm Refractor Travel Moon Kit
#10034 **$89.99**

Orion® Starshoot™ Pro Mono Astrophotography Camera
#52031 **$399.99**

Orion® XT6 Classic Dobsonian Telescope & Beginner Barlow Kit
#27193 **$359.99**

Orion® Starblast™ 90mm AZ Telescope & Beginner Barlow Kit
#27300 **$319.99**

Orion® Awesome AutoGuider Telescope Package
#24770 **$429.99**

Orion® StarShoot™ G3 Deep Space Color Imaging Camera
#53082 **$420.99**

Orion® SkyScanner™ 100mm Tabletop Reflector Telescope
#10012 **$123.59**

Orion® ED80T CF Triplet Apochromatic Refractor Telescope
#9534 **$949.99**

Orion® Planetary Observing Guide Kit
#25703 **$49.99**

Orion® SteadyPix™ Universal Smartphone Telescope Photo Mount
#5337 **$47.99**

Shopping has never been easier.

To learn more about our products and see a larger assortment, check out the digital eCatalogs on our website!

OrionTelescopes.com
800-447-1001
Or visit an Orion Authorised Dealer:

British Columbia
Canadian Telescopes
3430 Brighton Ave, Unit 204B
Burnaby, British Columbia
V5A 3H4

Alberta
All-Star Telescope
31020 HWY 2A Box 765
Didsbury, Alberta
T0M 0W0

Ontario
KW Telescope
25 Manitou Drive, Unit 3D
Kitchener, Ontario
N2C 1K9

Quebec
La Maison de l'Astronomie P.L.
8074 St-Hubert Street
Montreal, Quebec
H2R 2P3

Alberta
The Science Shop
316 Southgate Centre
5015-111 St
Edmonton, T6H 4M6

All prices are in U.S. dollars, and do not include shipping, duties, brokerage, or taxes. Retail prices shown are current as of 01/04/16 from Orion. Prices are subject to change without notice. Please check OrionTelescopes.com for the most current pricing. Dealer pricing and/or promotions may vary.

CELESTRON

COMMAND THE COSMOS

SKYPORTAL APP **UPDATE** + STARSENSE

TWO OF CELESTRON'S CUTTING-EDGE TECHNOLOGIES JOIN FORCES

Groundbreaking enhancements now enable automatic telescope alignment and complete wireless control from your smart device. Astronomical observing has **NEVER** been easier!

HERE'S WHAT YOU NEED:

CELESTRON COMPUTERIZED TELESCOPE WITH WIFI

NexStar Evolution features built in WiFi, or upgrade most Celestron computerized telescopes using the SkyPortal WiFi module.* This allows full wireless control of your telescope from your smart device.

STARSENSE AUTOALIGN*

Attaches to your telescope and automatically aligns in 3 minutes or less; no need to identify or locate alignment stars.

SMARTPHONE DEVICE OR TABLET

Download or update the **FREE** Celestron SkyPortal app for Android or iOS.

APP + WIFI + STARSENSE = AUTOMATIC ALIGNMENT - WIRELESSLY!

Google play | App Store

CANADA PREMIER SELECT DEALERS

Khan Scope Centre - www.khanscope.com
La Maison de l' Astronomie - www.maisonastronomie.ca
All-Star Telescope - www.all-startelescope.com
Focus Scientific - www.focusscientific.com
KW Telescope-Perceptor - www.kwtelescope.com
Canadian Telescopes - www.canadiantelescopes.com

* ACCESSORY SOLD SEPARATELY